Summary of Alberta Industrial and Municipal Effluent Quality Monitoring
1990 - 1995

Alberta
ENVIRONMENTAL PROTECTION

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Standards & Guidelines Branch
Environmental Assessment Division
Environmental Regulatory Service

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Table of Contents

Preface .... Preface
    Scope 1
    Revisions 2
    Acknowledgements 2

Industrial Sectors & Monitoring .... General
    Selection of Sectors & Facilities 1
    Selection of Data 2
    Analysis & Presentation 4
    Interpretation 5
    Results 7

Chemical Plants .... Tab 1 - Chemical Plant
    General 1
    Monitoring 2
    Results (BOD, COD, effluent flow, TOC, TSS) .... end of section

Fertilizer Plants .... Tab 2 - Fertilizer Plants
    General 1
    Monitoring 2
    Results (ammonia, effluent flow, organic N, phosphate, TSS) .... end of section

Meat Processing Plants .... Tab 3 - Meat Processing Plants
    General 1
    Monitoring 2
    Results (ammonia, BOD, effluent flow, oil & grease, TSS) .... end of section

Municipal Wastewater Treatment Plants   Tab 4 -Municipal Wastewater Treatment Plants
    General 1
    Monitoring 2
    Results (ammonia, BOD, effluent flow, phosphorous, TSS) .... end of section

Power Plants .... Tab 5 - Power Plants
    General 1
    Monitoring 2
    Results (chlorine, effluent flow, iron, nitrogen, phosphorous, TSS) .... end of section

Pulp & Paper Mills .... Tab 6 - Pulp & Paper Mills
General 1
Facilities 1
Monitoring 3
Results (AOX, BOD, COD, colour, effluent flow, nutrients, TSS, trace organics, others) .... end of section

Refineries .... Tab 7 - Refineries
General .... - 7
Monitoring 8
Results (ammonia, effluent flow, phosphate, TSS) .... end of section

Tar Sands Plants .... Tab 8 - Tar Sands Plants
General 1
Monitoring 2
Results (ammonia, COD, effluent flow, oil & grease, phenols, sulphide, TSS) ...... end of section

Appendices .... Tab 9 - Appendices
Appendix 1 - Regulated Parameters 1
Appendix 2 - Glossary of Terms 2

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Summary of Alberta Industrial & Municipal Effluent Quality Monitoring
1990-1995

Preface

Scope

This report was developed by the Standards and Guidelines Branch[*] as a component of a multi-phase project designed to provide the public, government and industry with up-to-date and accurate information about facility standards and monitoring requirements. Phase I reviewed how industrial discharges are controlled and can be found in the publication *Summary of Alberta Standards & Monitoring Requirements*[**] July, 1995. Phase II provides industry's discharge performance relative to these requirements.

The industrial effluent quality data upon which most of the following graphs and charts are based are industry-generated and were obtained from the electronic database maintained by the Industrial Wastewater Branch of AEP. The municipal effluent quality data were obtained directly from the municipalities.

Revisions

A previous edition of this report has already been released[***]. This report contains the following changes over the previous edition:

- Some municipal wastewater treatment plants have now been incorporated as a new sector, bringing the total number of sectors covered in this report to eight.

- The dataset for Pulp & Paper Mills has now been extended to the end of 1995. This changes the previously published calculated averages for 1995 slightly as that previous dataset ended in October, 1995.

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[*] formerly the Source Standards Branch

[**] Alberta Environmental Protection, Environmental Regulatory Service, *Summary of Alberta Standards & Monitoring Requirements*, July, 1995.

[***] *Summary of Alberta Industrial Effluent Quality Monitoring, 1990-1995* was first released in July, 1996.

- Additional monitoring data (mostly representing the period 1990 to early 1994) for certain trace organic contaminants and biological nutrients have been incorporated into the presentation of Pulp & Paper mills.
- For the Pulp & Paper Mills, the calculation of production-based parameters has now been clarified and (in certain cases) corrected. This reflects the fact that since only specific pulp & paper mills typically release certain chlorinated organic contaminants, the resultant production-based aggregate should be referenced specifically to those mills.

Acknowledgements

This report was authored for the Standards & Guidelines Branch by Brian Yaremko with the coordination and assistance of Ian Mackenzie. The Standards & Guidelines Branch gratefully recognizes the assistance of the following: Ken Deagle, Industrial Wastewater Branch; and all reviewers, both within AEP and in industry.

Industrial Sectors & Monitoring

Selection of Sectors & Facilities

AEP has subdivided industrial and municipal operations in Alberta into a set of twenty-three sectors. These are listed in the following table. From this set, eight sectors have been chosen for analysis and detailed presentation in this report and are highlighted in the following table.

sector	total number of facilities	facilities approved for direct discharge[1]	facilities presented in this report
asphalt plants	68	-	-
CHEMICAL PLANTS	48	10	10
coal processing	9	-	-
concrete & cement	9	-	-
secondary earth products	9	-	-
FERTILIZER PLANTS	10	4	4
fish farms & hatcheries	3	-	-
food processing	6	-	-
foundry	2	-	-
gas processing	487	-	-
MEAT PROCESSING	26	1	1
metal products	4	-	-
MUNICIPAL WWTP	> 900	≈ 500	6
potato processing	3	-	-
POWER PLANTS	10	7	7
PULP MILLS	7	7	7
rapeseed plants	2	-	-
REFINERIES	9	3	3
rendering plants	3	-	-
salt caverns	6	-	-
sand & gravel washing	109	-	-
TAR SANDS	32	1	1
wood processing	22	-	-

These eight sectors were selected with respect to several factors including the size of the facilities, the magnitudes of the facilities' effluent discharges, and the quantity or availability of reported monitoring data. Nearly every commercial facility approved by AEP to discharge effluent to a watercourse in Alberta is included within these eight sectors.

Any facilities which do not practice direct discharge to receiving watercourses but which are still included in the eight selected sectors either discharge to an alternate receptor (*e.g.* municipal wastewater systems, irrigation, holding tanks, deep well injection) or are approved for air emissions only. They are not addressed in this report.

The remaining 15 sectors are not discussed in this report but may be addressed in future revisions.

Selection of Data

Of the decades of available data* which potentially could have been incorporated into this report, only the most recent data, covering the period 1990-1995, were selected for inclusion. The decision to concentrate on this most recent period was based primarily upon two factors. First, only the most recent data, reflecting the latest improvements in industrial technology, are representative of industry's current state of operations. Second, while data from newly received monitoring reports are immediately entered into AEP's computer database, there remains a large body of older data which have not been converted to digital format and which thus remain not readily usable.

For each industrial sector, there is a specific set of *regulated* water quality parameters defined for each approval issued under the terms of Alberta's Environmental Protection & Enhancement Act. The actual composition of each set depends directly upon several factors, including the nature of the particular sector, the chemical and physical processes employed therein, the products and by-products typically generated, and the potential impacts of such an effluent upon the environment. Of the regulated parameters, some are *limited* by means of government-mandated end-of-pipe effluent limits, while the remainder (those not subject to end-of-pipe limits) are simply *monitored*. Thus, every limited parameter must be monitored, though not every monitored parameter is limited. APPENDIX 1 contains a summary of every water-quality parameter for which discharge monitoring requirements are currently imposed for each of the twenty-three sectors in Alberta.

For the eight sectors addressed in this report, the effluent quality parameters selected for presentation varied from sector to sector depending upon a number of factors including the availability of data in electronic format, the frequency of sampling, and the general importance of each parameter with respect to the assessment of water quality. In general, this report addresses most of the *limited* parameters together with a few *monitored* parameters for each facility within each sector. These parameters are summarised by sector in the following table:

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* *e.g.* data for the Weldwood plant can be found dating back some forty years

Summary of Discharge Monitoring by Sector
Limited and/or Monitored Parameters Addressed in this Report

	sector:							
parameter:	chemical plants	fertilizer plants	meat processors	municipal WWTP	power plants	pulp & paper mills	refineries	tar sands plants
AOX						✓		
BOD_5	✓		✓	✓		✓		
residual Cl					✓			
COD	✓					✓		✓
colour						✓		
flow	✓	✓	✓	✓	✓	✓	✓	✓
Fe					✓			
NH_3-N		✓	✓	✓			✓	✓
nutrients						✓		
oil & grease			✓					✓
organic N		✓						
others						✓		
phenols								✓
phosphate		✓					✓	
total P				✓	✓			
sulphide								✓
TOC	✓							
total N					✓			
TSS	✓	✓	✓	✓	✓	✓	✓	✓
trace organics						✓		

Three of these general parameters (which apply only to the pulp & paper mills) are further subdivided in this report: *nutrients*, *trace organics* and *others*. These will be discussed more fully in the discussion of PULP & PAPER MILLS later in this report.

For more information concerning the regulation of monitoring of effluent discharges, the *Summary of Alberta Standards & Monitoring Requirements*, may be consulted. For an explanation of some of the more important parameters, terms and concepts addressed in this report, a glossary is provided in APPENDIX 2.

Analysis & Presentation

The selected monitoring data were subjected to a simple statistical analysis consisting of the calculation of the arithmetic mean or average:

$$\bar{x} = \frac{\sum_{n=1}^{n} x_n}{\sum n}$$

and the sample standard deviation:

$$s = \sqrt{\frac{\sum_{n=1}^{n} (x_n - \bar{x})^2}{n - 1}}$$

where x_n is a single measurement and n is the total number of available samples. These parameters were calculated over two periods of time: a single year of the data record, and the entire bulk six-year period 1990-1995. In effect, calculation of the average in this manner amounts to dividing the total amount of effluent substance[*] released by the total number of days in which discharge occurred, thereby yielding an estimate of the typical daily rate of effluent release *only on those days when the facility is actually releasing effluent*.

Aggregate average daily values (defined as the arithmetic sum of the individual plants' annually averaged daily productions of a given substance over a given, common period of time) were also determined for each sector. These aggregate averages may be treated as general indicators of the overall bulk quantity of a given substance that is released to the receiving environment over a given period of time and were determined via one of two approaches. In the first approach, individual annual averages for each facility were summed across the sector for a specific parameter, thereby yielding the sector-wide aggregate quantity. In the second approach, whenever monitoring data were available for every *operating* facility in the sector *on the same given day*, the reported results were summed across the sector for that day, and then all such daily sums over the entire year were averaged. In general, it was found that for any given year, these two methods yielded very similar estimates of the aggregate daily average, especially for larger data sets.

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[*] This may be either a specific contaminant, such as BOD or TSS, or it may be a non-contaminant such as effluent flow.

For the pulp & paper mills only, the annually averaged daily release of a given contaminant was also referenced directly to the annually averaged daily production of pulp during that same year, thereby yielding a *production-based* expression of each mill's daily contaminant loading for each year of record. In considering all mills collectively with respect to pulp production, a *ratio of aggregates* was calculated whereby the sector-wide aggregate daily release of a given contaminant in a given year was divided directly by the sector-wide aggregate daily pulp production in that same year in order to define a sector-wide estimate of the production-based daily contaminant loading in a given year.

The results of the statistical analysis are presented in tabular form, and in a variety of graphical formats including time-series charts, 3-dimensional bar charts and cumulative frequency distributions for every year in which monitoring data were available. Where possible, the currently imposed end-of-pipe limits were plotted on the same histograms, allowing some assessment of a given facility's performance during the period of interest. In addition, pie-charts were created for each parameter within each sector by defining the aggregate daily average (via the first approach above) and then using this average as a reference total for depicting the facilities' individual contributions[*]. The aggregate daily average (calculated via the second approach above) was also applied to the pulp & paper mills to define the subject dataset for both the time-series charts and the subsequently calculated thirty-day moving average for the aggregate condition. The thirty-day moving average smooths the often scattered data, thus allowing any longer-term trends to be more visible.

Interpretation

The goal of this report was to present several years of effluent quality data in a concise, direct graphical format. However, given the means of data selection and analysis which was employed here, a number of factors must be considered when interpreting the resultant sets of charts and tables:

1. ***Each facility is different:***

   With respect to general operations, even within the same sector, some facilities operate differently from others: most employ continuous effluent discharge while others employ an intermittent batch discharge; some subject their wastewater to a fairly elaborate treatment system before release while others pass it through a settling pond or storage lagoon before release; monitoring data may thus be available for a fraction of a year, over the entire year but at irregular or wide intervals, or not for years at a time. With respect to the monitored substances, varieties of the same general parameter can be reported: one facility may report extractable iron, free available chlorine and organic nitrogen, while another may report total iron, free residual chlorine and total nitrogen; a few facilities are allowed to report net values of a given parameter (*i.e.* the absolute difference between the influent and effluent concentrations of a given parameter) while most facilities are now required to report absolute values (the actual end-of-pipe concentration, regardless of what the influent and background concentrations may be). Consequently, any instance where two facilities are compared must be considered with caution.

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[*] Caution must be exercised in the interpretation of the resultant tables, histograms, pie charts and bar charts - this is discussed fully in the **Interpretation** section below.

In preparing the following sets of charts and tables, an attempt was made to recognize such facility-specific operational factors:

- Considering the calculation of annual daily averages for each parameter and for each facility, because such averages represent the facility's performance only on the days when the facility is actually releasing effluent, a statement of the facility's mode of effluent release (either continuous or batch[*]) is provided in order to preclude any interpretive misconceptions.

- Because the comparison of annual averages (as calculated in this report) from a continuously discharging facility and a batch facility can become less meaningful as an indicator of each facility's relative demands upon the environment if the batch facility discharges at a low or sporadic frequency, the batch facilities were completely excluded from the calculation of the mass-based aggregate daily averages. Consequently, the contributions of the batch facilities were also not incorporated into both the 3-dimensional bar charts and the pie charts[**].

- Both the average and standard deviation were determined for those parameters which are monitored as net values, and these quantities are presented in the subsequent tables. However, given the fundamental difference between net and absolute values, a direct comparison of the two types is of little value. Thus, net values were completely excluded from the calculation of the aggregate average, and from the preparation of both the 3-dimensional bar charts and the pie charts.

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[*] Each facility was designated as either continuously discharging or as batch based upon examination of the frequency of monitoring data, comments from industry, and discussion with appropriate staff at AEP.

[**] An exception was the municipal wastewater treatment plants where all plants were plotted together even though one was a batch facility. This was done only when the effluent monitoring data were expressed in mg/l because the concentration-based (mg/l) individual concentrations could indeed be compared directly regardless of whether or not discharge was continuous or batch.

In practical terms, given their relative rarity, the exclusion of both batch facilities and facilities measuring net values from certain components of this analysis is of little consequence. Although the resultant aggregates and charts are not, in such cases, an absolute indication of the relative contributions of *every* facility in a given industrial sector, they are nonetheless indicative of the relative contributions of *most* of the facilities considered in this report. In any case, timeseries plots and histograms are provided for every parameter at every facility, regardless of that facility's mode of operation.

2. ***Only the daily limits for 1995 are plotted on the frequency histograms:***

While the frequency histograms presented in this report were based upon the entire period 1990-1995, only the 1995 daily limit was actually shown on them. In practical terms, the absence of any exceedance of this limit on a histogram may or may not imply that the facility has operated free of infractions* over the entire period of interest depending upon the actual magnitudes of the imposed limits during the previous approvals (*i.e.* earlier in the dataset). That is, if consistently more stringent limits are set for a given facility every year, data collected in 1990 may now appear to be in violation with respect to the 1995 limit, even though those same data may have been well within the existing limit in 1990.

3. ***The selected sectors are not necessarily the only contributors of a given contaminant to the receiving stream:***

As APPENDIX 1 indicates, there are fifteen industrial sectors and many regulated parameters which were not addressed in this report. The eight sectors addressed here must not be thought to be the only potential contributors of a given contaminant to a receiving stream - such contaminants could also be introduced by the remaining fifteen sectors. For instance, if a pulp & paper mill and municipal wastewater treatment plant (WWTP) reside adjacent to one another and discharge into the same river, the pulp & paper mill's monitoring data cannot be taken as the absolute indication of the total BOD loading on that river without also considering the contribution of the wastewater treatment plant. In this regard, a basin-specific statement of loading of a given contaminant from *all* sources within a given basin would have been useful as a means of assessing industry's absolute demands - such an approach could not easily be followed within the scope of the present report.

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* Regardless of what appears on the histograms, this report is not in any way intended to be an indictment of industry. This report is provided for informational purposes only.

4. ***End-of-pipe limits are expressed in both kg/d in mg/l:***

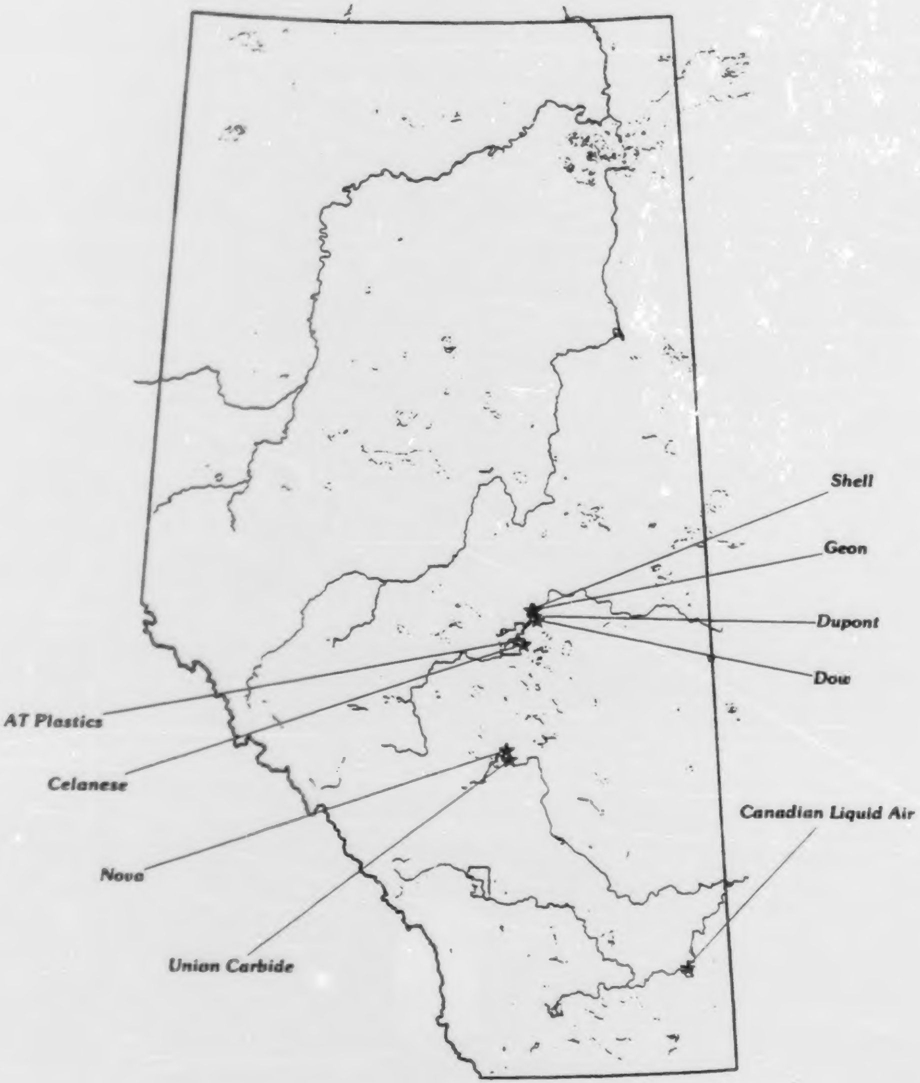
   In most cases, AEP has chosen to set limits in units of kg/d, while a handful are regulated in mg/l. In this report, units of kg/d were used as a standard. Data reported by industry in units of mg/l were converted to kg/d whenever a discharge was available, while in cases where this conversion was not possible, the data were plotted in mg/l. For the specific case of municipal WWTP's, effluent limits are still typically set by AEP in units of mg/l, and therefore, effluent monitoring data for these facilities are reported *both* in units of mg/l (for consistency with the AEP-mandated limit) as well as in units of kg/d (for consistency with the rest of the report).

Finally, given the variety of both chemical processes and production capacities which generally characterize the different facilities operating within a given industrial sector, it was not practical to set the charts' axes to the same scale for every facility. Although a constant scale would have enabled a simple means of visual comparison among the various plants, such an approach was abandoned in the interest of clarity.

Results

Summaries for each of the eight selected industrial sectors for the period 1990-1995 are presented in the following sections. Each summary is prefaced by a brief introduction wherein each sector is described with respect to its general operations, its constituent plants' geographical location in Alberta, and any currently imposed end-of-pipe limits.

Chemical Plants


Shell
Geon
Dupont
Dow
AT Plastics
Celanese
Canadian Liquid Air
Nova
Union Carbide

Canadian Liquid Air	BOD	not applicable	not applicable
	COD	14	7
	TOC	not applicable	not applicable
	TSS	14	7
Celanese (north flume)	BOD	not applicable	not applicable
	COD	102	51
	TOC	82	41
	TSS	102	51
Celanese (south flume)	BOD	2826	1413
	COD	5652	2826
	TOC	2770	1385
	TSS	5652	2826
Dow	BOD	not applicable	not applicable
	COD	not applicable	not applicable
	TOC	900	400
	TSS	750	400
DuPont	BOD	14	7
	COD	not applicable	not applicable
	TOC	not applicable	not applicable
	TSS	14	7
Geon	BOD	not applicable	not applicable
	COD	not applicable	not applicable
	TOC	65	22
	TSS	42	14
Nova*	BOD	not applicable	not applicable

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* Nova employs intermittent batch discharge as opposed to continuous effluent release.

	COD	not applicable	not applicable
	TOC	805	269
	TSS	538	179
Shell[*]	BOD	not applicable	not applicable
	COD	not applicable	not applicable
	TOC	880	440
	TSS[**]	587	293
Union Carbide	BOD	not applicable	not applicable
	COD	not applicable	not applicable
	TOC	200	450
	TSS	250	100

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[*] Shell employs intermittent batch discharge as opposed to continuous effluent release.

[**] Shell is regulated for NFR, non-filterable residue, not TSS.

Chemical Plants

General

This sector comprises plants that produce or manufacture both organic and inorganic chemicals from organic and inorganic starting materials. Given Alberta's abundant petroleum-based natural resources, an important subset of this sector is petrochemical plants - plants which manufacture products from petroleum-based organic starting materials. Although oil refineries and natural gas processing plants are somewhat similar in function to chemical plants (or more specifically to petrochemical plants), these are treated by AEP as separate industrial sectors.

Of the forty eight chemical plants which are approved in Alberta, only twelve are approved for direct effluent discharge to a watercourse, and of these, nine* are addressed in this report. These plants are summarized in the following table.

Chemical Plants General Information

plant	receiving stream	location	major products	opened[2]
AT Plastics	North Saskatchewan River	Edmonton	polyethylene resins, vinyl acetate, copolymer resins, compounds of ethylene & polyethylene	pre-1990
Canadian Liquid Air	South Saskatchewan River	Medicine Hat	purified carbon dioxide	pre-1990
Celanese	North Saskatchewan River	Edmonton	acetic acid, acetic anhydride, ethanal, methanol, 2-butanone, ethyl acetate, formaldehyde	pre-1990
Dow	North Saskatchewan River	Fort Saskatchewan	glycol, ethylene oxide, chlorine, sodium hydroxide, foam board, ethylene dichloride, vinyl chloride, polyethylene	pre-1990
DuPont	North Saskatchewan River	Gibbons	hydrogen peroxide	1991
Geon	North Saskatchewan River	Scotford	polyvinyl chloride	pre-1990

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* Actually, ten are considered here since the Celanese plant in Edmonton receives two separate discharge approvals from AEP, one for each of two flumes.

plant	receiving stream	location	major products	opened[2]
Nova	Red Deer River	Joffre	ethylene, polyethylene, purified hydrogen	pre-1990
Shell	North Saskatchewan River	Scotford	styrene	pre-1990
Union Carbide	Red Deer River	Prentiss	ethylene glycol, diethylene glycol, heavy glycols	pre-1990

Future expansions are either expected soon or have already been announced at DuPont, Nova, Union Carbide & Dow, so both the roster of major products and the imposed end-of-pipe limits will likely need to be revised in the future.

Monitoring

Although there are twenty-three separate discharge monitoring requirements for this sector, only five of these, BOD*, COD, TOC, TSS & flow were examined. Limits for these parameters are summarized in the following table:

Chemical Plants Mandated Effluent Limits

plant	parameter	1995 daily limit (kg/d) (unless	1995 monthly limit (kg/d)
AT Plastics	BOD	not applicable	not applicable
	COD	100 ppm	nil
	TOC	not applicable	not applicable
	TSS	30 ppm	nil

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* Shorthand expressions such as these are very common in the field of water quality analysis. They are described in more detailed terms in APPENDIX 2.

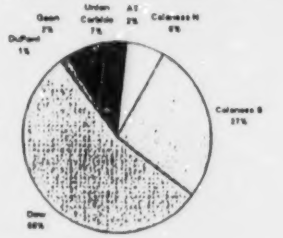
Biochemical Oxygen Demand (BOD)

Performance Summary: Chemical Plants

Average Daily BOD Loading for 1995

non-batch facilities only

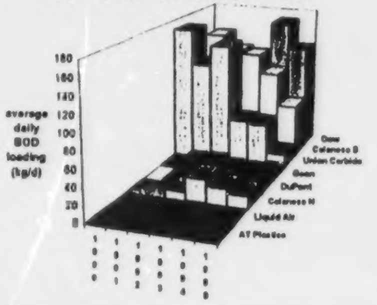
100% = 244.2 kg/d aggregate BOD loading



Performance Summary: Chemical Plants

Annually Averaged Daily BOD Loading

all plants except Nova & Shell ; 1990-1995



		calculation of aggregate for plants with continuous discharge & absolute measurements only (kg/d):										aggregate (kg/d):
		AT	Liquid Air	Celanese N	Celanese S	Dow	DuPont	Geon	Nova	Shell	Union Carbide	all
mode of operation:		continuous	continuous	continuous	continuous	continuous	continuous	continuous	batch	batch	continuous	
total samples 1990-1995:		190	97	181	351	130	1680	219	548	690	370	
average for:	1990	-	-	-	117.4	-		-			167.9	285.3
	1991	-	-	-	164.0	-	3.0	7.6			124.4	298.9
	1992	6.3	-	10.6	135.6	-	2.9	9.2			150.6	314.1
	1993	2.6	1.3	28.8	131.4	96.6	1.7	4.0			55.9	322.3
	1994	2.9	0.1	20.8	107.8	106.6	3.6	3.1			63.2	309.0
	1995	3.8	0.1	15.6	67.0	132.9	3.2	6.4			18.3	244.2
	1990-1995	3.7	0.1	20.0	119.0	130.9	2.9	6.6			96.4	384.7

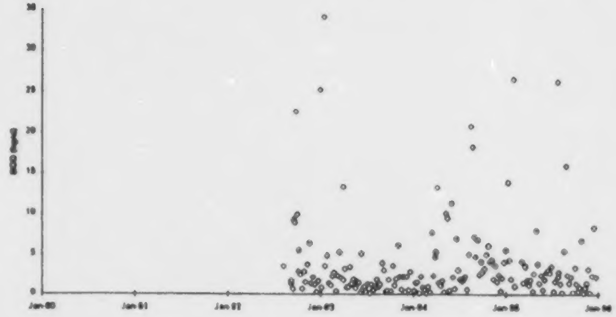
BOD: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
AT	-	-	-	-	6.3	6.7	2.6	4.9	3.9	4.3	3.8	6.6	-	-
Liquid Air	-	-	-	-	-	-	1.3	2.3	0.1	0.2	0.1	0.1	-	-
Celanese N	-	-	-	-	10.6	7.0	28.8	41.2	20.8	34.1	15.6	12.8	-	-
Celanese S	117.4	108.5	164.0	175.8	135.6	75.1	131.4	95.6	107.8	76.6	67.0	47.2	2826	1413
Dow	-	-	-	-	-	-	96.6	103.8	106.6	112.7	132.9	88.6	-	-
DuPont	-	-	3.0	2.3	2.9	1.8	1.7	1.3	3.6	2.5	3.2	6.3	14	7
Geon	-	-	7.6	3.8	9.2	11.5	4.0	3.4	3.1	3.6	6.4	6.1	-	-
Novacor	-	-	37.0	19.7	13.6	9.0	19.9	18.4	19.6	17.0	18.1	15.8	-	-
Shell	4.5	2.2	9.7	7.6	5.8	3.4	4.9	3.4	5.4	3.2	6.7	3.0	-	-
Union Carbide	167.9	283.6	124.4	109.9	150.6	118.8	55.9	62.9	63.2	63.4	18.3	22.0	-	-

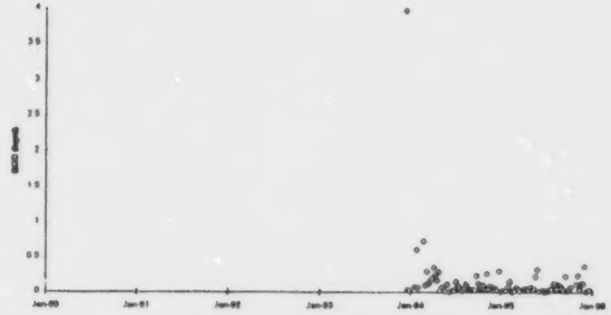
	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	daily	monthly
Shell	4.5	2.2	9.7	7.6	5.8	3.4	4.9	3.4	5.4	3.2	6.7	3.0	-	-

+3

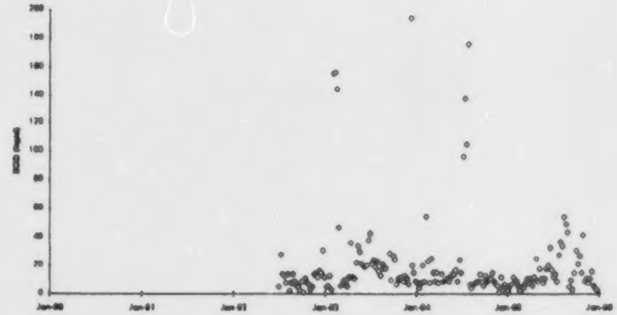
Performance Summary: Chemical Plants
Individual Daily BOD Loading - Time Series
AT Plastics: 1990-1996



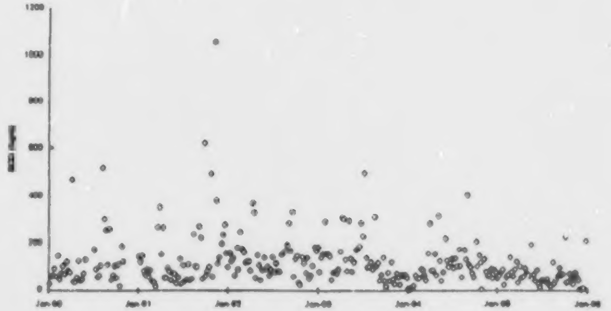
Performance Summary: Chemical Plants
Individual Daily BOD Loading - Time Series
Canadian Liquid Air: 1993-1996

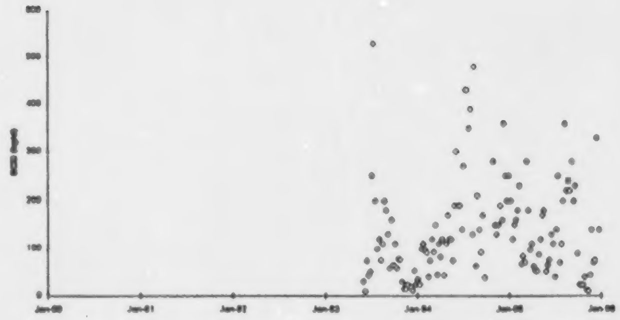


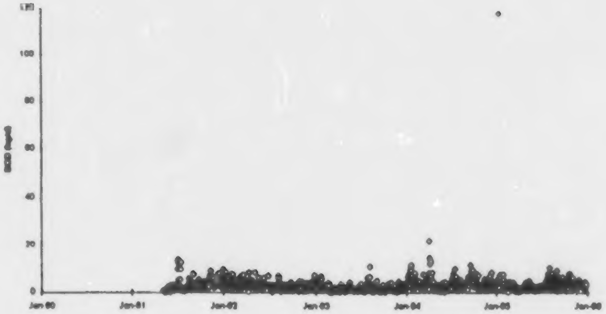
Performance Summary: Chemical Plants
Individual Daily BOD Loading - Time Series
Celanese (North Flume): 1990-1996

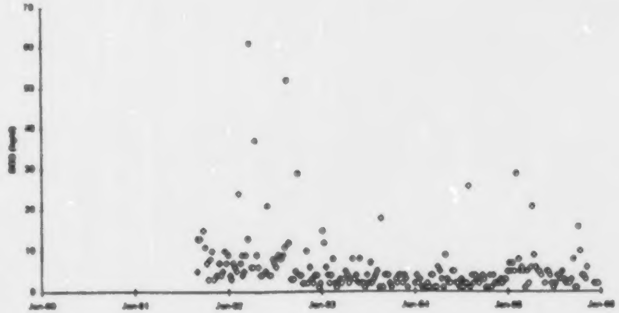


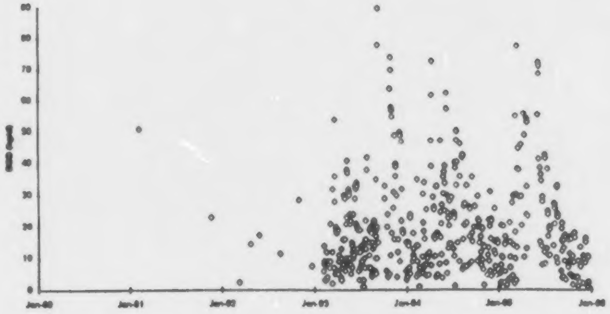
Performance Summary: Chemical Plants
Individual Daily BOD Loading - Time Series
Celanese (South Flume): 1990-1996

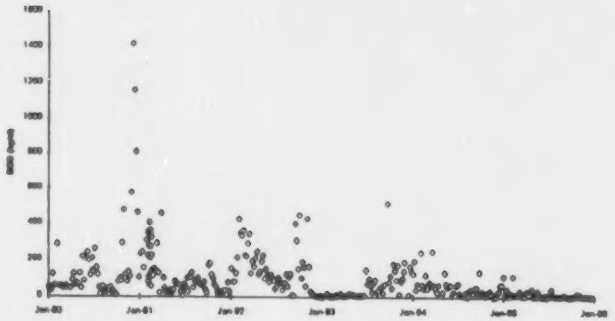



Performance Summary: Chemical Plants
Individual Daily BOD Loading - Time Series
Dow Chemical Canada: 1990-1995

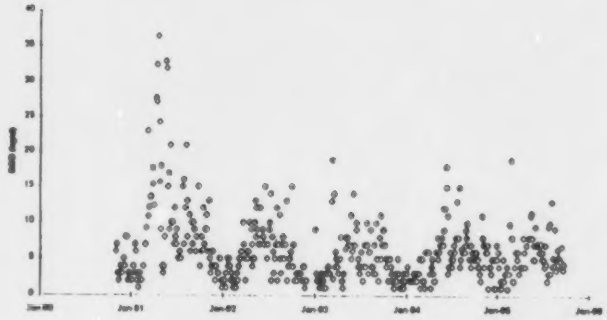

Performance Summary: Chemical Plants
Individual Daily BOD Loading - Time Series
DuPont Canada: 1991-1995


Performance Summary: Chemical Plants
Individual Daily BOD Loading - Time Series
Geon Canada: 1990-1995


Performance Summary: Chemical Plants
Individual Daily BOD Loading - Time Series
Nova Chemicals: 1990-1995

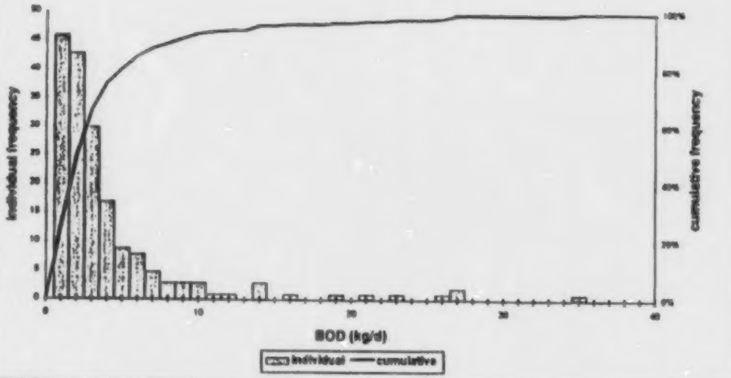


Performance Summary: Chemical Plants
Individual Daily BOD Loading - Time Series
Union Carbide: 1990-1995

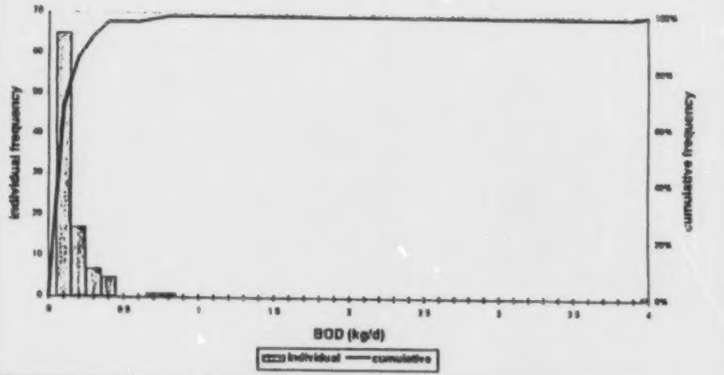


Performance Summary: Chemical Plants
Individual Daily BOD Loading - Time Series
Shell Canada: 1990-1995

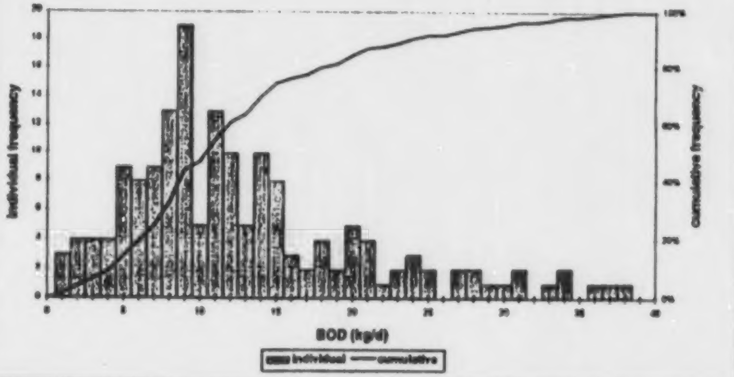
Performance Summary: Chemical Plants
Individual Daily BOD Loading - Frequency Distribution
AT Plastics: 1990-1995



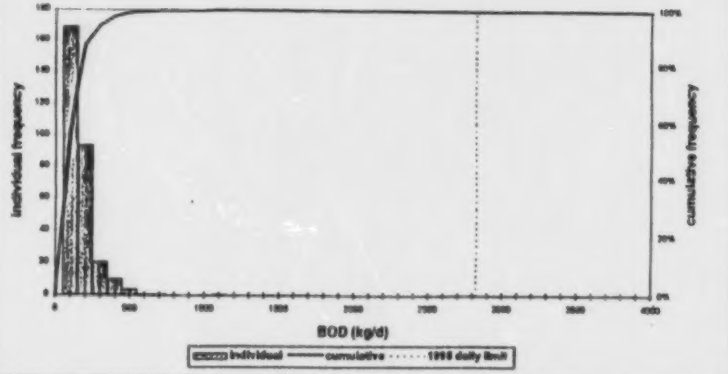
Performance Summary: Chemical Plants
Individual Daily BOD Loading - Frequency Distribution
Canadian Liquid Air: 1993-1995

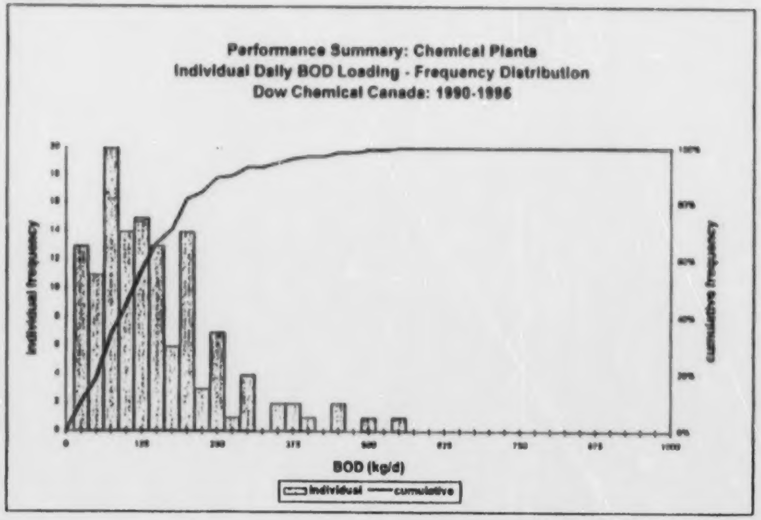


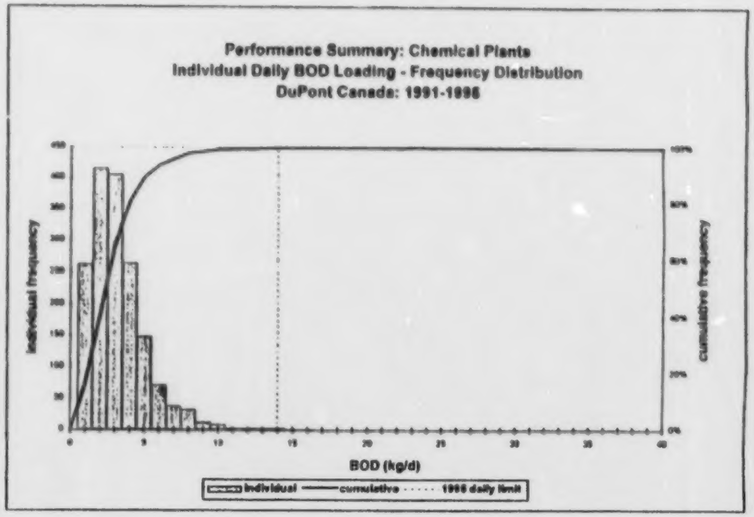
Performance Summary: Chemical Plants
Individual Daily BOD Loading - Frequency Distribution
Celanese (North Flume): 1990-1995

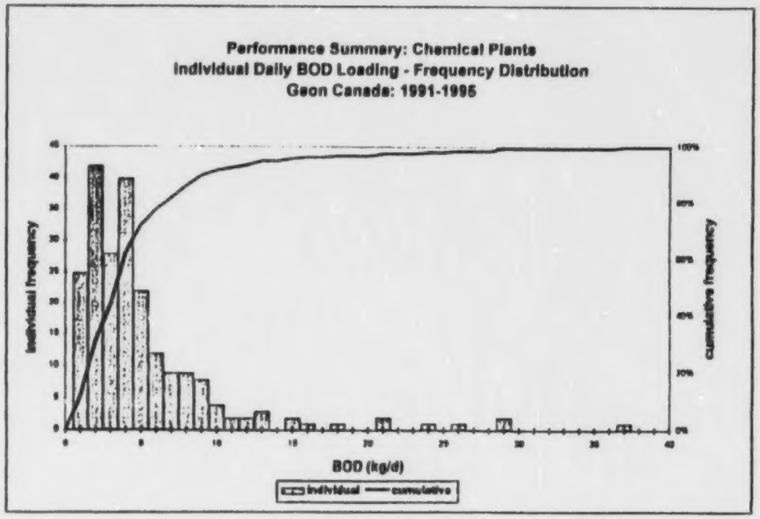


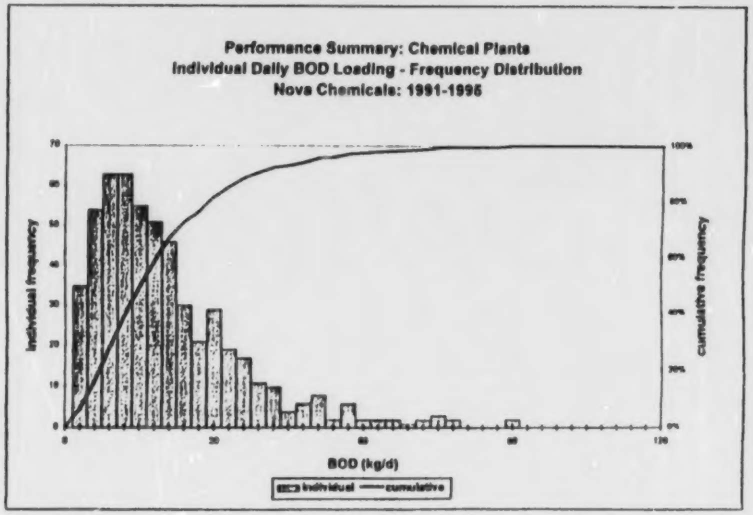
Performance Summary: Chemical Plants
Individual Daily BOD Loading - Frequency Distribution
Celanese (South Flume): 1990-1995



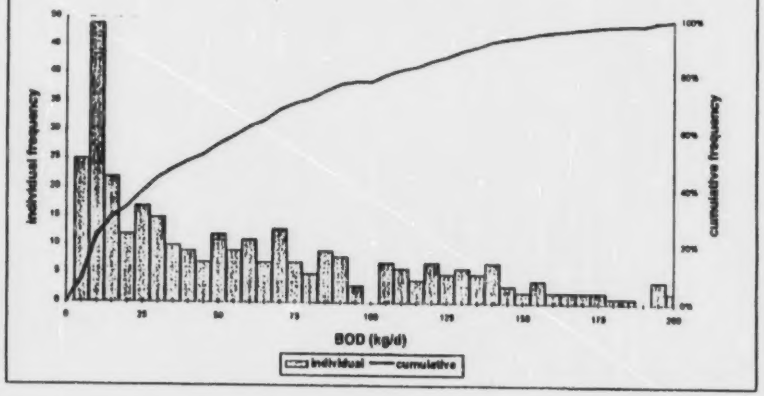

Performance Summary: Chemical Plants
Individual Daily BOD Loading - Frequency Distribution
Dow Chemical Canada: 1990-1995


Performance Summary: Chemical Plants
Individual Daily BOD Loading - Frequency Distribution
DuPont Canada: 1991-1995

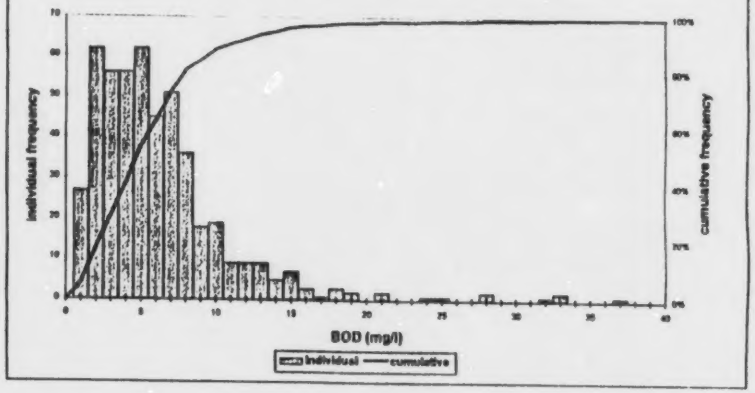

Performance Summary: Chemical Plants
Individual Daily BOD Loading - Frequency Distribution
Geon Canada: 1991-1995


Performance Summary: Chemical Plants
Individual Daily BOD Loading - Frequency Distribution
Nova Chemicals: 1991-1995

Performance Summary: Chemical Plants
Individual Daily BOD Loading - Frequency Distribution
Union Carbide: 1991-1996

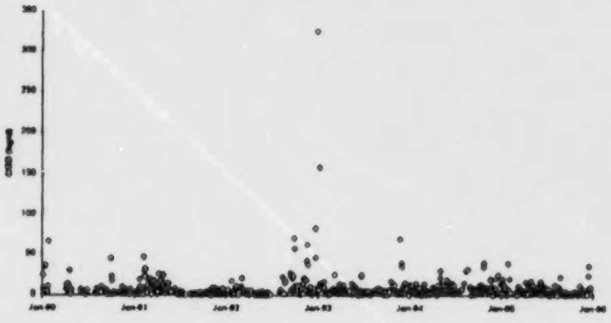


Performance Summary: Chemical Plants
Individual Daily BOD Loading - Frequency Distribution
Shell Canada: 1991-1996

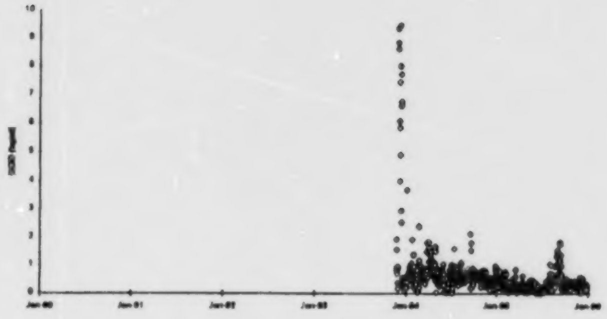


Chemical Oxygen Demand
(COD)

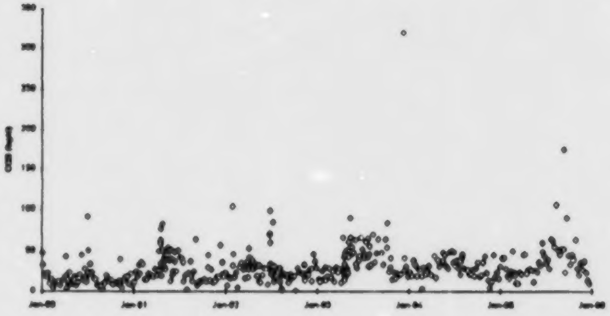
Performance Summary: Chemical Plants
Individual Daily COD Loading - Time Series
AT Plastics: 1990-1995



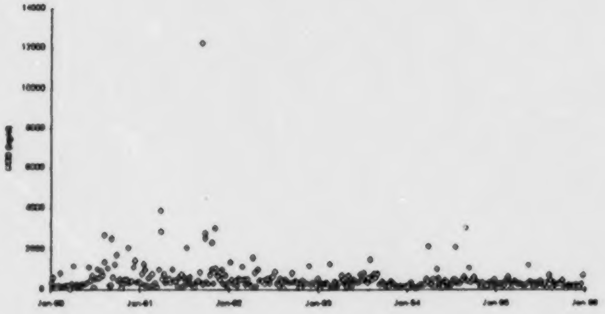
Performance Summary: Chemical Plants
Individual Daily COD Loading - Time Series
Canadian Liquid Air: 1993-1995



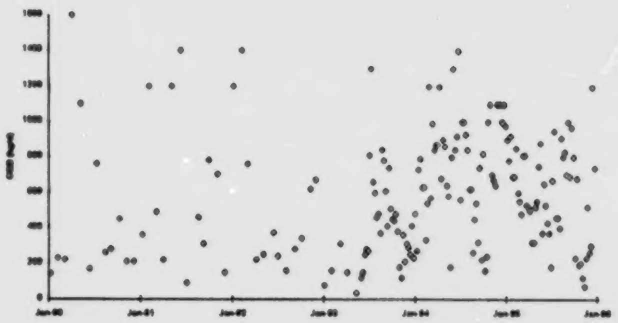
Performance Summary: Chemical Plants
Individual Daily COD Loading - Time Series
Celanese (North Flume): 1990-1995



Performance Summary: Chemical Plants
Individual Daily COD Loading - Time Series
Celanese (South Flume): 1990-1995

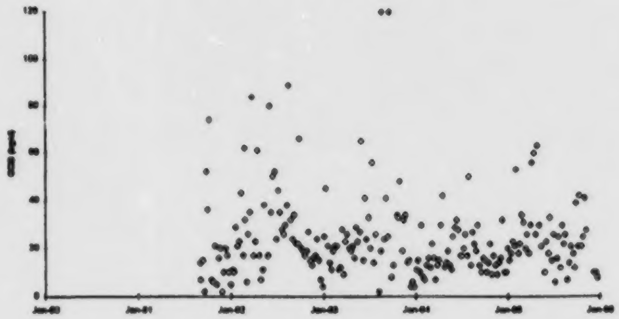


Performance Summary: Chemical Plants
Individual Daily COD Loading - Time Series
Dow Chemical Canada: 1990-1995

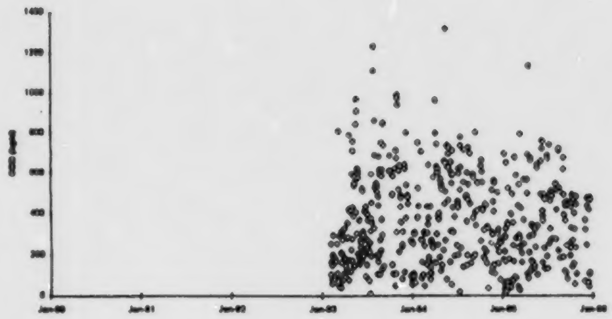


Performance Summary: Chemical Plants
Individual Daily COD Loading - Time Series
DuPont Canada: 1991-1995

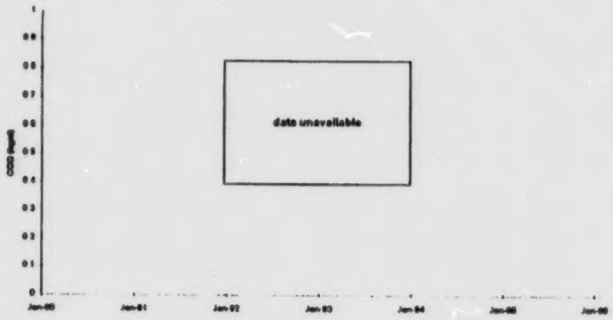
Performance Summary: Chemical Plants
Individual Daily COD Loading - Time Series
Geon Canada: 1990-1995



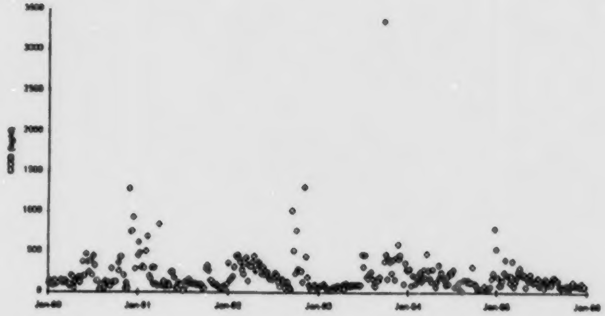
Performance Summary: Chemical Plants
Individual Daily COD Loading - Time Series
Nova Chemicals: 1990-1995



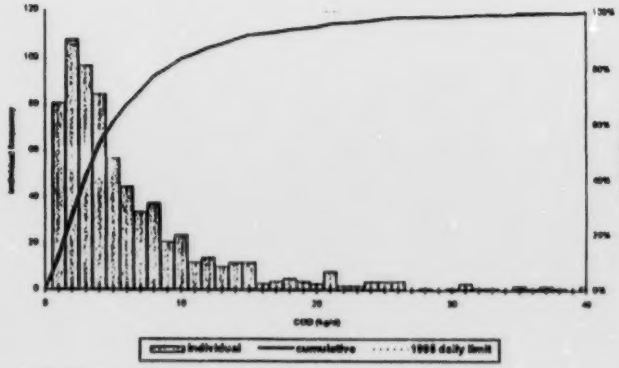
Performance Summary: Chemical Plants
Individual Daily COD Loading - Time Series
Shell Canada Products: 1990-1995



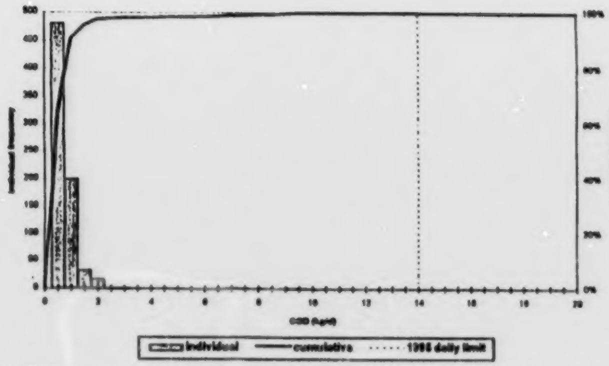
Performance Summary: Chemical Plants
Individual Daily COD Loading - Time Series
Union Carbide: 1990-1995



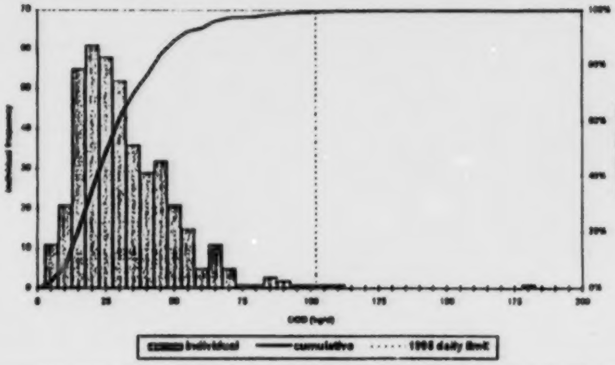
Performance Summary: Chemical Plants
Individual Daily COD Loading - Frequency Distribution
AT Plastics: 1990-1995



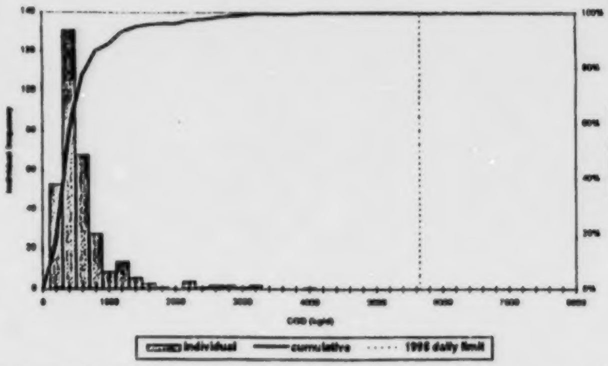
Performance Summary: Chemical Plants
Individual Daily COD Loading - Frequency Distribution
Canadian Liquid Air: 1993-1995



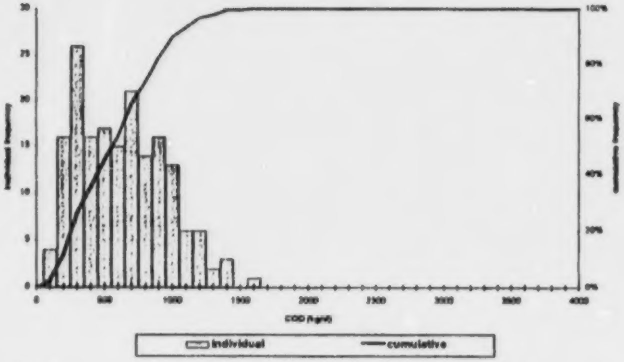
Performance Summary: Chemical Plants
Individual Daily COD Loading - Frequency Distribution
Celanese (North Flume): 1990-1995



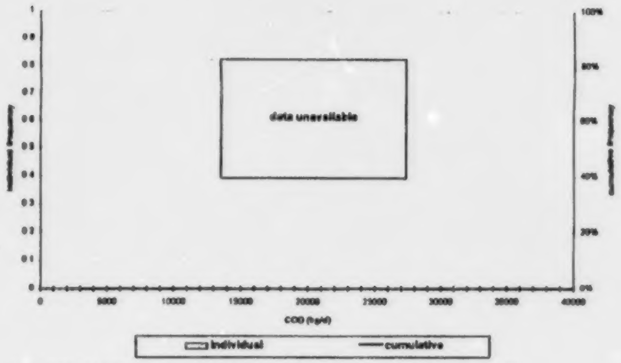
Performance Summary: Chemical Plants
Individual Daily COD Loading - Frequency Distribution
Celanese (South Flume): 1990-1995



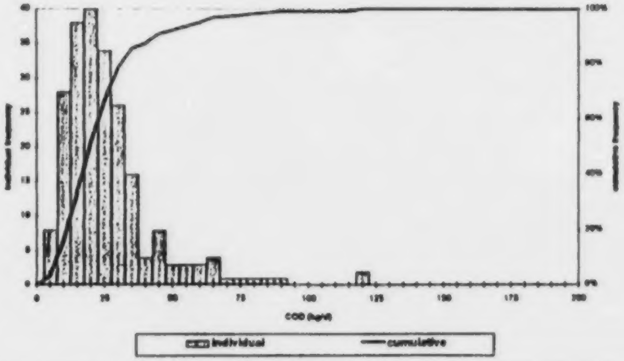
Performance Summary: Chemical Plants
Individual Daily COD Loading - Frequency Distribution
Dow Chemical Canada: 1990-1995



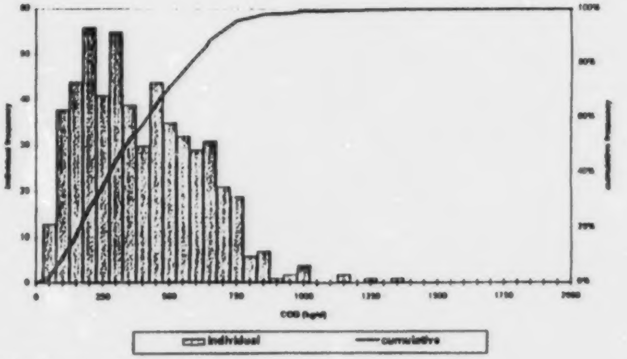
Performance Summary: Chemical Plants
Individual Daily COD Loading - Frequency Distribution
DuPont Canada: 1991-1995



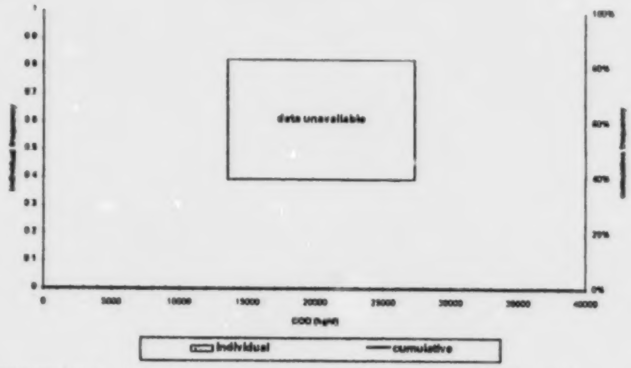
Performance Summary: Chemical Plants
Individual Daily COD Loading - Frequency Distribution
Geon Canada: 1991-1995



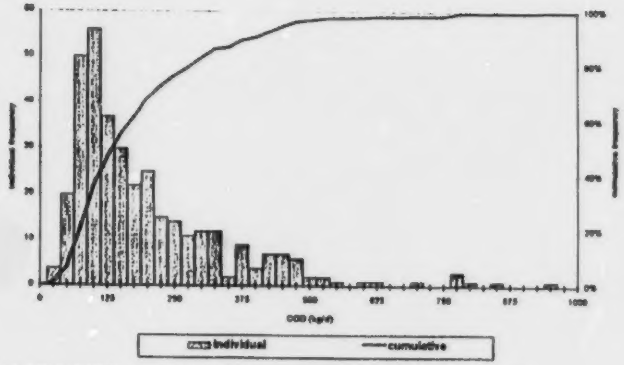
Performance Summary: Chemical Plants
Individual Daily COD Loading - Frequency Distribution
Nova Chemicals: 1991-1995



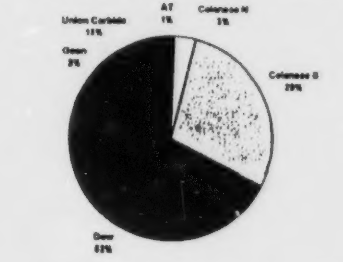
Performance Summary: Chemical Plants
Individual Daily COD Loading - Frequency Distribution
Shell Canada Products: 1991-1996



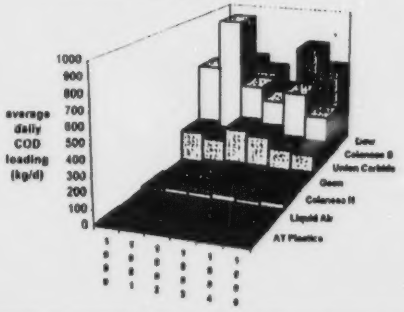
Performance Summary: Chemical Plants
Individual Daily COD Loading - Frequency Distribution
Union Carbide: 1991-1996



Performance Summary: Chemical Plants
Average Daily COD Loading for 1995
non-batch facilities only
100% = 1134.4 kg/d aggregate COD loading



Performance Summary: Chemical Plants
Annually Averaged Daily COD Loading
all plants except DuPont, Nova & Shell ; 1990-1995



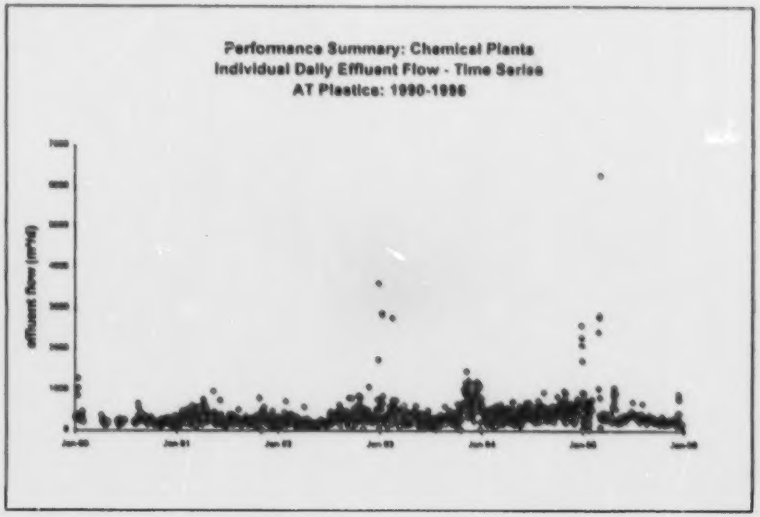
Calculation of aggregate for plants with continuous discharge & absolute measurements only (kg/d):

		AT Plastics	Liquid Air	Celanese N	Celanese S	Dow	DuPont	Geon	Nova	Shell	Union Carbide	aggregate (kg/d): all
mode of operation:		continuous	continuous	continuous	continuous	continuous	continuous	continuous	batch	batch	continuous	
total samples 1990-1995:		721	750	425	327	176	0	222	551	0	361	
average for:	1990	7.4	-	18.6	620.7	469.4	-	-			217.3	1333.4
	1991	5.7	-	30.4	977.6	613.5	-	18.6			176.7	1821.4
	1992	11.7	-	27.6	498.6	542.5	-	29.0			268.2	1377.6
	1993	7.3	2.9	40.1	409.0	402.3	-	27.0			233.5	1122.0
	1994	7.3	0.6	29.1	481.1	747.6	-	17.9			164.8	1448.4
	1995	6.2	0.3	38.6	324.3	593.5	-	24.7			146.8	1134.4
	1990-1995	7.5	0.6	30.8	563.1	589.3	-	24.1			201.0	1416.5

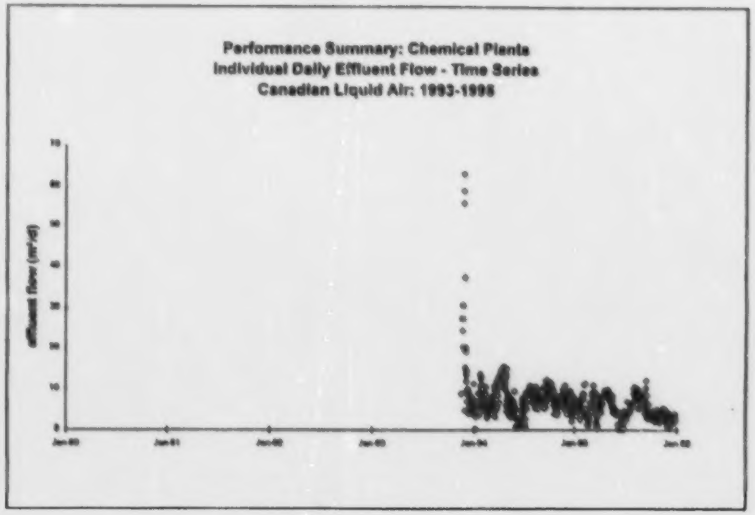
COD: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

plant	1990 x (kg/d)	s (kg/d)	1991 x (kg/d)	s (kg/d)	1992 x (kg/d)	s (kg/d)	1993 x (kg/d)	s (kg/d)	1994 x (kg/d)	s (kg/d)	1995 x (kg/d)	s (kg/d)	1995 imposed limits (kg/d): daily	monthly
AT	7.4	11.0	5.7	7.4	11.7	33.4	7.3	15.2	7.3	7.2	6.2	6.3	0	100 ppm
Liquid Air	-	-	-	-	-	-	2.9	3.3	0.6	0.4	0.3	0.3	14	7
Celanese N	18.6	14.4	30.4	16.4	27.6	18.4	40.1	35.9	29.1	11.1	38.6	26.5	102	51
Celanese S	620.7	589.4	977.6	1669.8	498.6	312.2	409.0	277.0	481.1	537.8	324.3	195.4	5652	2826
Dow	469.4	456.3	613.5	445.0	542.5	405.0	402.3	262.6	747.6	303.7	593.5	266.3	-	-
DuPont	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Geon	-	-	18.6	18.6	29.0	19.8	27.0	23.1	17.9	9.0	24.7	13.2	-	-
Nova	-	-	-	-	-	-	374.7	241.6	392.2	217.3	347.7	203.6	-	-
Shell	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Union Carbide	217.3	226.9	176.7	167.2	268.2	220.6	233.5	442.7	164.8	125.6	146.8	91.6	-	-

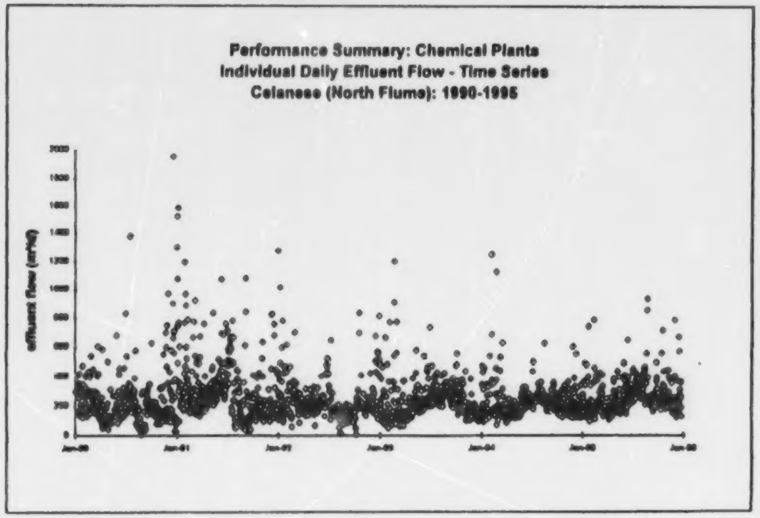
Effluent Flow



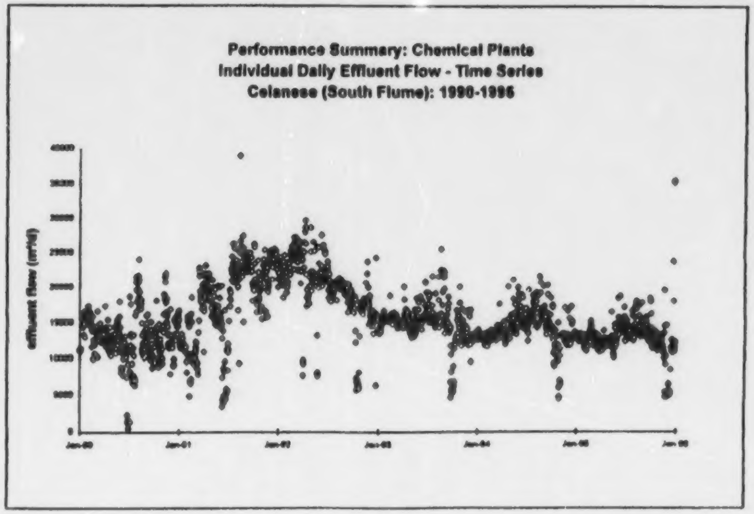
Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Time Series
AT Plastics: 1990-1996



Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Time Series
Canadian Liquid Air: 1993-1996

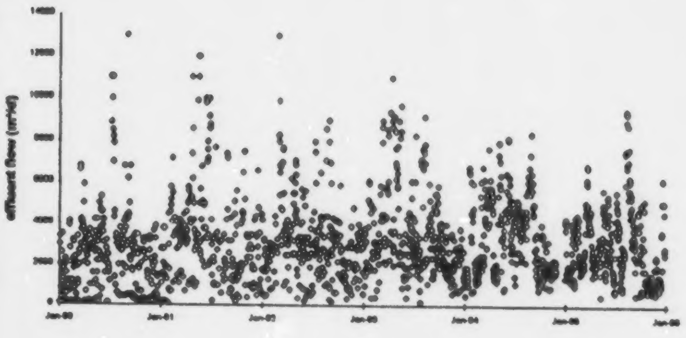


Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Time Series
Celanese (North Flume): 1990-1995

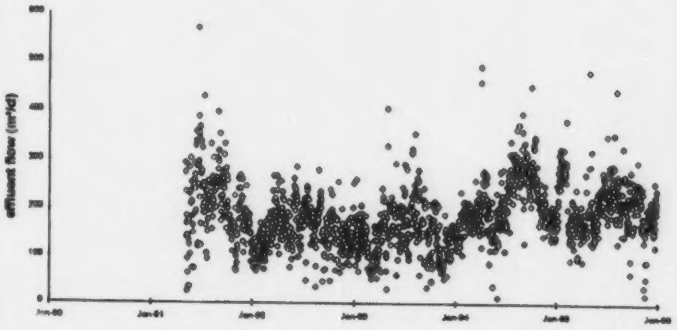


Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Time Series
Celanese (South Flume): 1990-1996

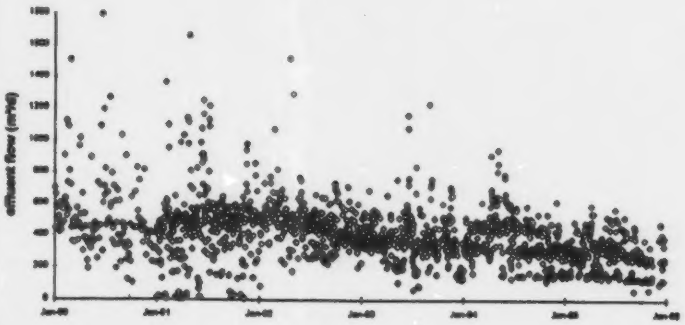
Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Time Series
Dow Chemical Canada: 1990-1995



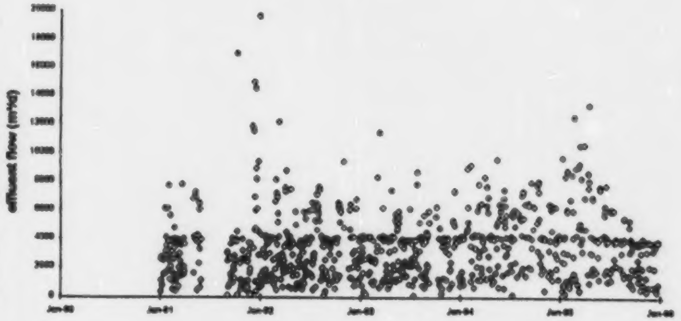
Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Time Series
DuPont Canada: 1991-1995

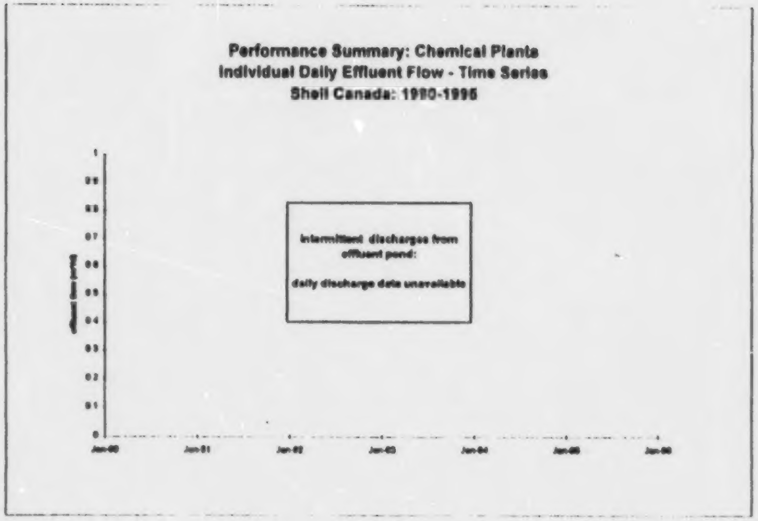


Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Time Series
Geon Canada: 1990-1995

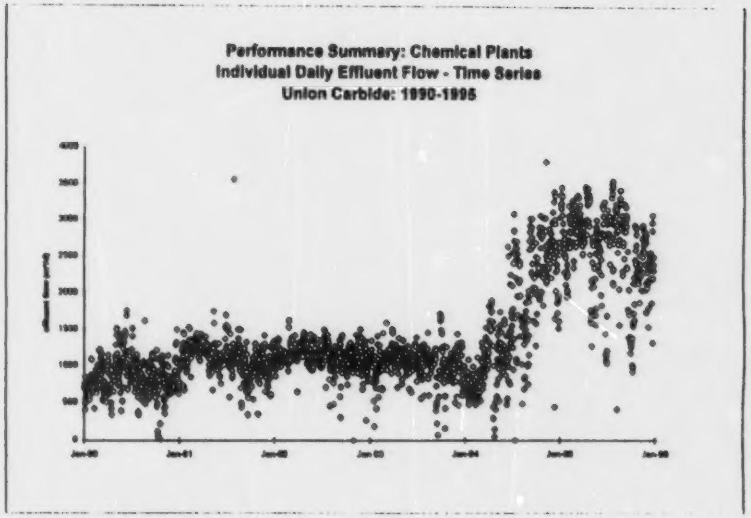


Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Time Series
Nova Chemicals: 1990-1995



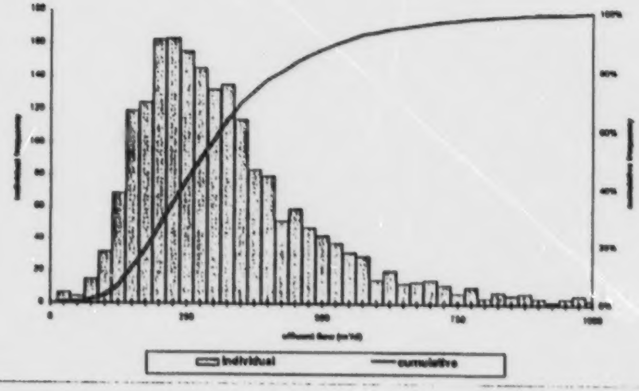


Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Time Series
Shell Canada: 1990-1995

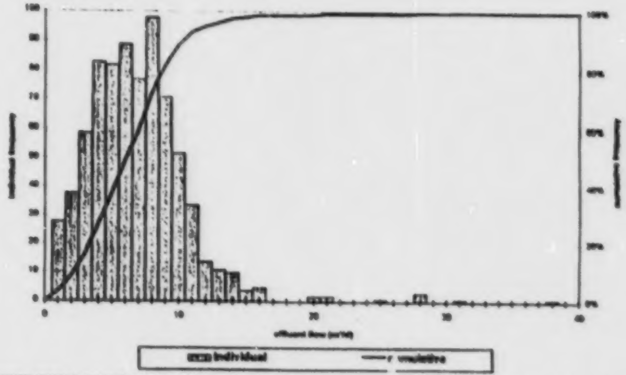


Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Time Series
Union Carbide: 1990-1995

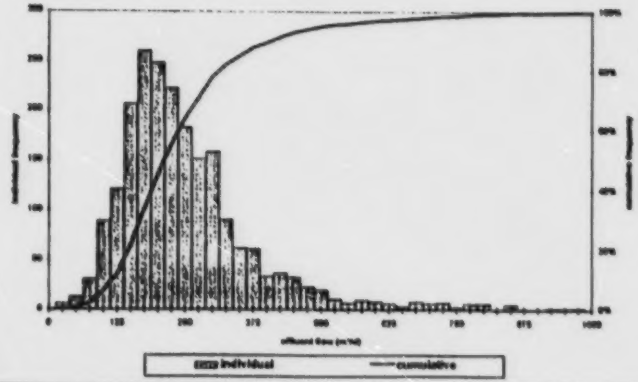
Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Frequency Distribution
AT Plastics: 1990-1995



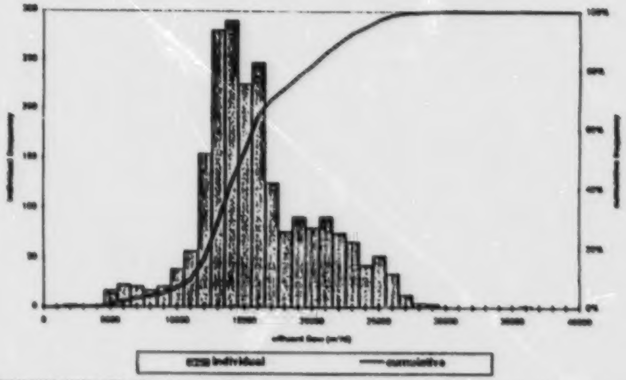
Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Frequency Distribution
Canadian Liquid Air: 1993-1995



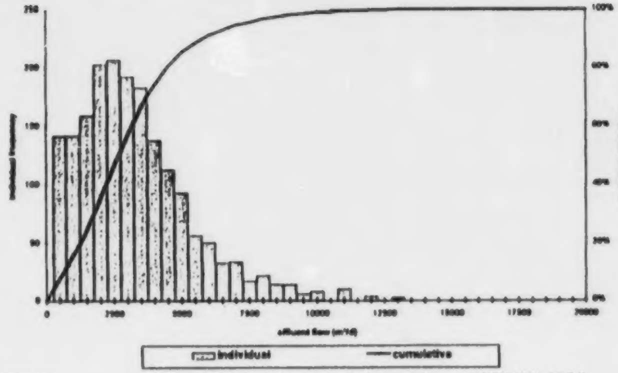
Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Frequency Distribution
Celanese (North Flume): 1990-1995



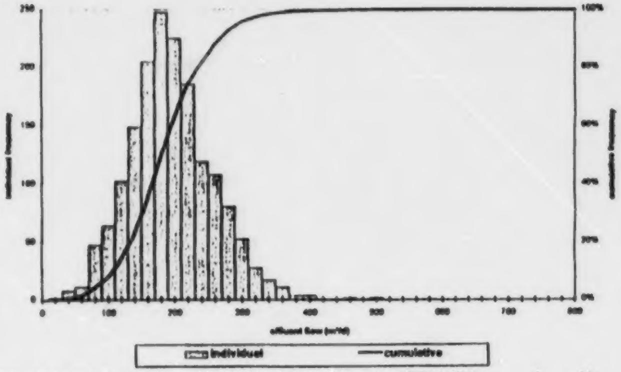
Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Frequency Distribution
Celanese (South Flume): 1990-1995



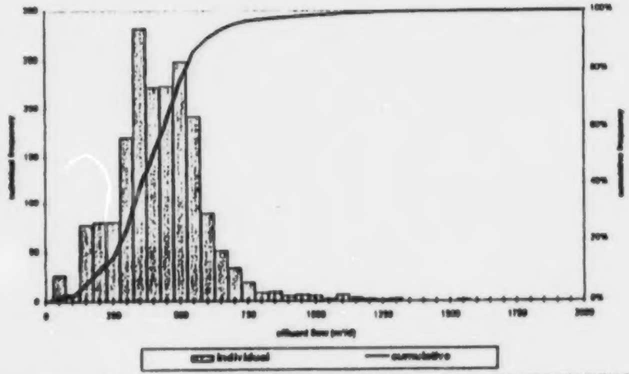
Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Frequency Distribution
Dow Chemical Canada: 1990-1995



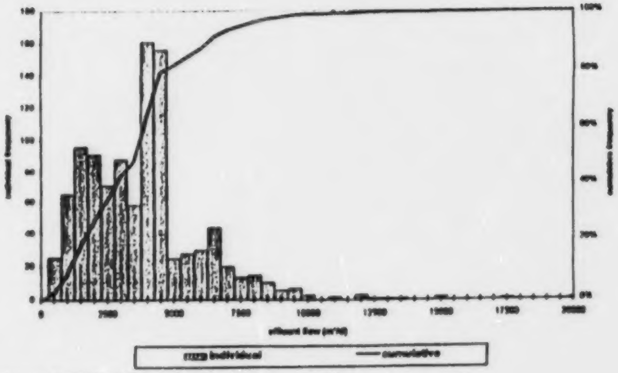
Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Frequency Distribution
DuPont Canada: 1991-1995



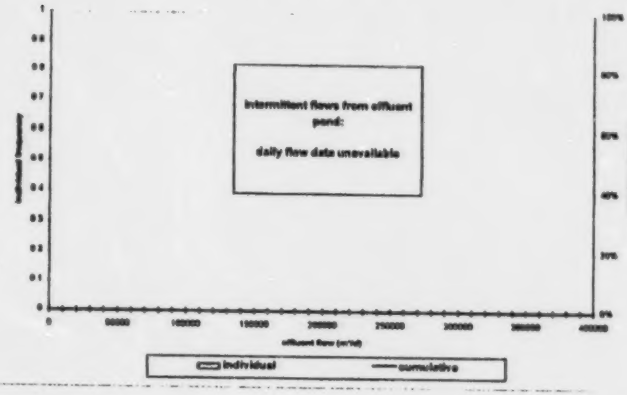
Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Frequency Distribution
Geon Canada: 1991-1995



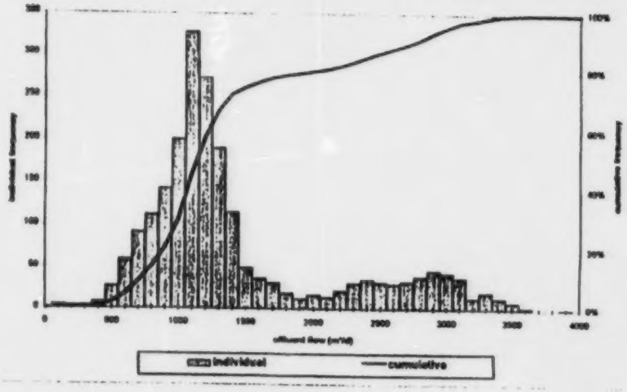
Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Frequency Distribution
Nova Chemicals: 1991-1995



Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Frequency Distribution
Shell Canada: 1991-1996



Performance Summary: Chemical Plants
Individual Daily Effluent Flow - Frequency Distribution
Union Carbide: 1991-1996

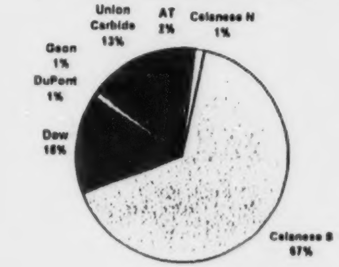


Performance Summary: Chemical Plants

Average Daily Effluent Flow for 1995

non-batch facilities only

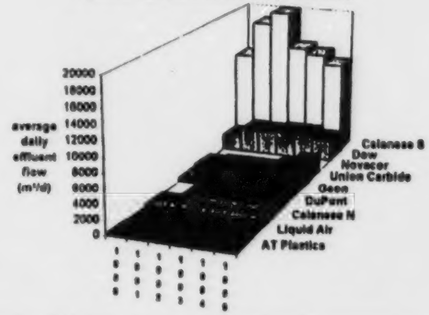
100% = 19518.3 m³/d aggregate effluent flow



Performance Summary: Chemical Plants

Annually Averaged Daily Effluent Flow

all plants except Nova & Shell ; 1990-1995



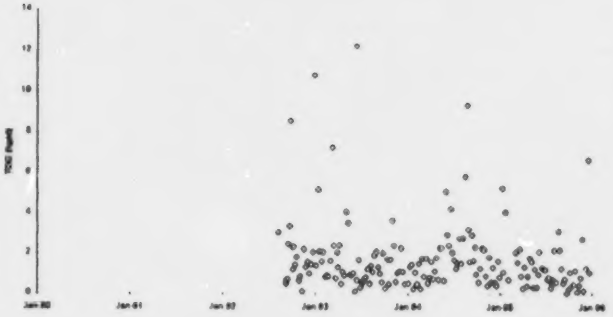
calculation of aggregate for plants with continuous discharge & absolute measurements (m³/d):

		AT	Liquid Air	Celanese N	Celanese S	Dow	DuPont	Geon	Nova	Shell	Union Carbide	aggregate (m³/d): all
mode of operation:		continuous	continuous	continuous	continuous	continuous	continuous	continuous	batch	batch	continuous	
total samples 1990-1995:		2040	768	2168	2190	1851	1682	1876	1028	0	2173	
average for:	1990	239.6	-	230.2	13137.1	2147.6	-	519.6			853.3	17127.7
	1991	270.5	-	313.1	18136.5	3349.3	209.2	484.6			1104.9	23848.1
	1992	279.9	-	228.9	19890.4	3276.6	165.0	473.6			1122.6	28425.9
	1993	404.1	15.3	238.5	14875.1	3888.1	162.0	378.1			1034.7	20662.9
	1994	429.2	7.2	224.8	14167.2	3837.6	213.0	372.1			1623.6	20574.7
	1995	365.6	5.0	285.5	12846.9	2950.3	207.1	291.2			2586.8	19518.3
	1990-1995	336.9	6.6	260.2	15511.5	3092.1	186.8	409.0			1388.9	21181.0

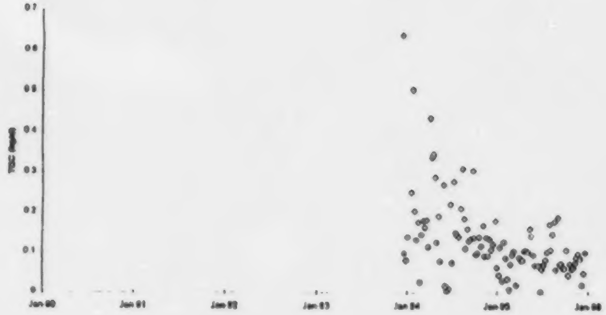
effluent flow: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1996 imposed limits (m³/d):	
plant	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	daily	monthly
AT	239.6	125.8	270.5	134.3	279.9	240.7	404.1	339.6	429.2	237.6	365.6	433.6	-	-
Liquid Air	-	-	-	-	-	-	15.3	14.9	7.2	3.1	5.0	2.6	-	-
Celanese_N	230.2	181.9	313.1	232.3	228.9	128.2	238.5	130.7	224.8	115.6	285.5	119.3	-	-
Celanese_S	13137.1	3235.6	18136.5	5669.2	19890.4	4443.3	14875.1	2606.2	14167.2	2343.3	12846.9	2917.4	-	-
Dow	2147.6	2173.6	3349.3	2498.1	3276.6	2066.8	3888.1	2109.3	3837.6	1831.6	2950.3	1703.4	-	-
DuPont	-	-	209.2	73.6	165.0	48.9	162.0	58.8	213.0	61.7	207.1	55.6	-	-
Geon	519.6	246.2	484.6	238.1	473.6	134.8	378.1	147.8	372.1	136.1	291.2	106.9	-	-
Nova	-	-	3370.9	2817.0	3361.5	1987.7	3224.4	1698.5	4183.8	2030.2	3744.7	2489.2	-	-
Shell	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Union Carbide	853.3	264.7	1104.9	248.5	1122.6	166.6	1034.7	223.4	1623.6	794.6	2586.8	874.9	-	-

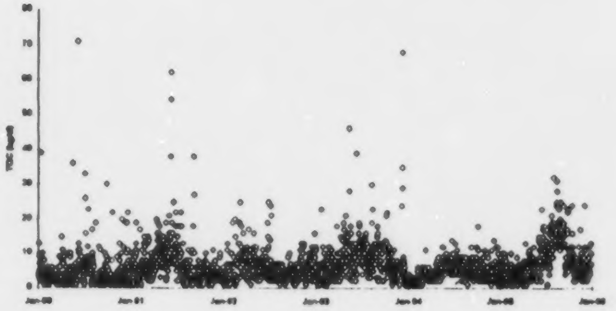
Total Organic Carbon
(TOC)



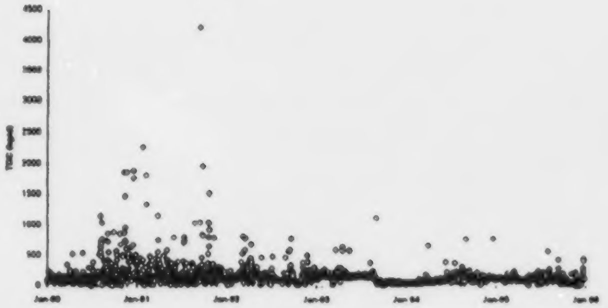
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Time Series
AT Plastics: 1990-1995



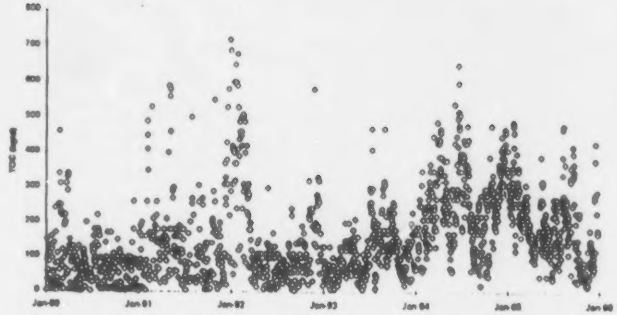
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Time Series
Canadian Liquid Air: 1993-1995



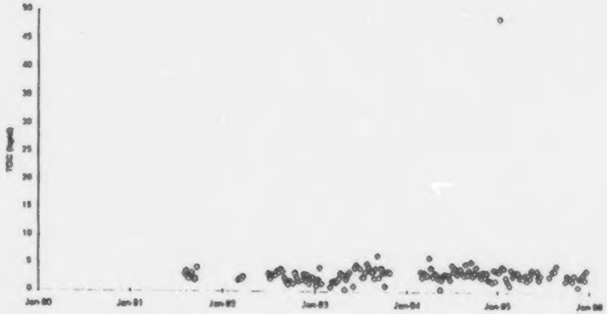
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Time Series
Celanese (North Flume): 1990-1995



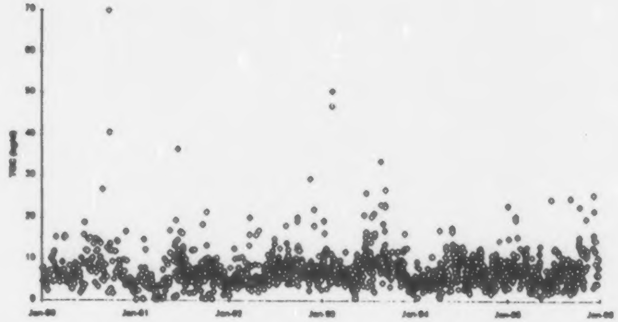
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Time Series
Celanese (South Flume): 1990-1995



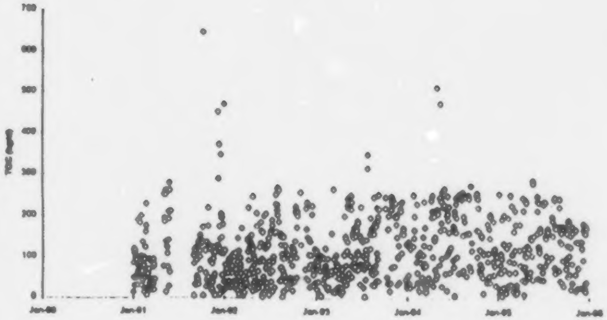
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Time Series
Dow Chemical Canada: 1990-1995



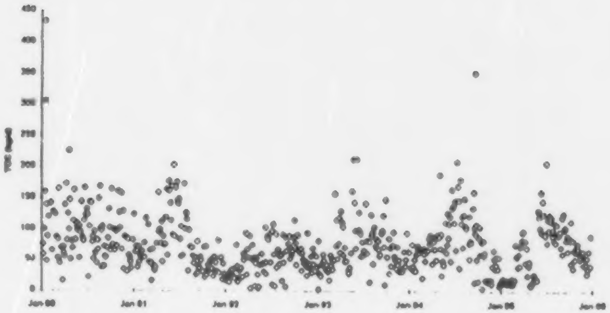
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Time Series
DuPont Canada: 1991-1995



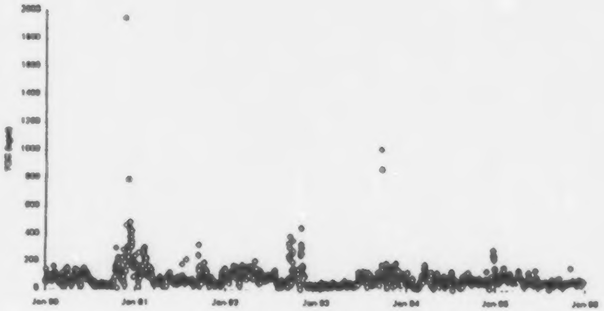
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Time Series
Geon Canada: 1990-1995



Performance Summary: Chemical Plants
Individual Daily TOC Loading - Time Series
Nova Chemicals: 1990-1995

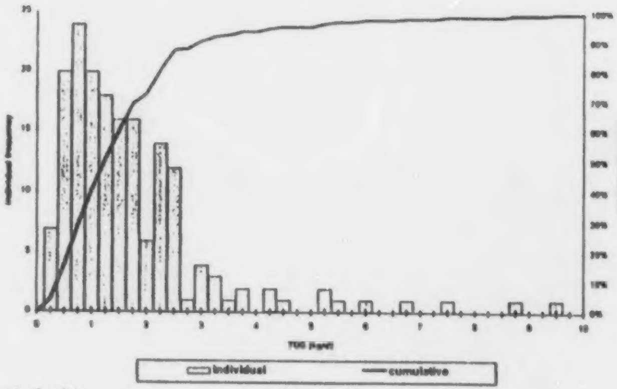


Performance Summary: Chemical Plants
Individual Daily TOC Loading - Time Series
Shell Canada: 1990-1995

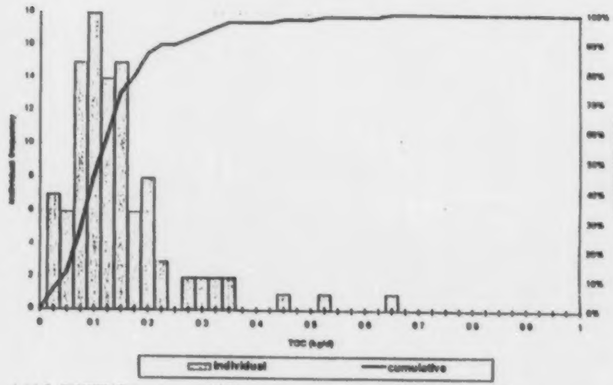


Performance Summary: Chemical Plants
Individual Daily TOC Loading - Time Series
Union Carbide: 1990-1995

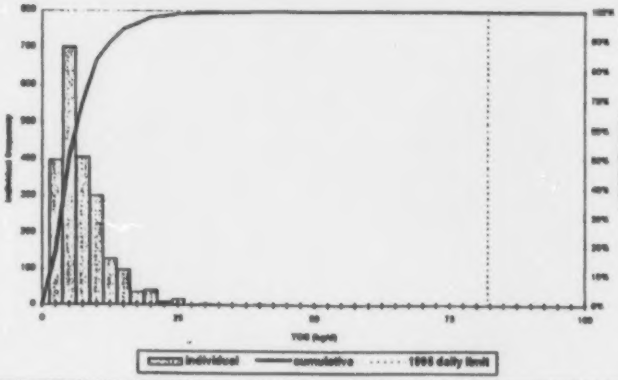
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Frequency Distribution
AT Plastics: 1990-1996



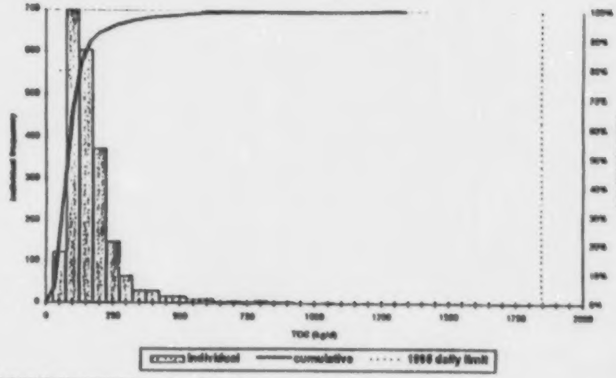
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Frequency Distribution
Canadian Liquid Air: 1993-1996



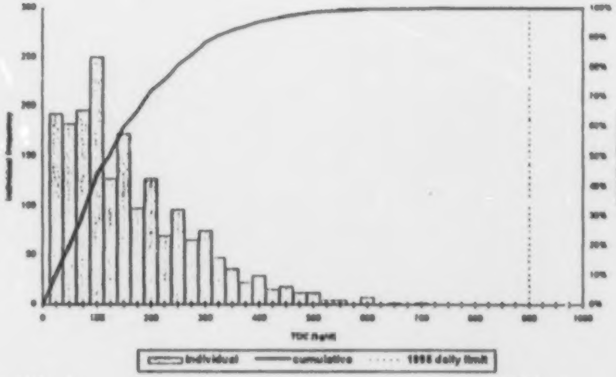
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Frequency Distribution
Celanese (North Flume): 1990-1996



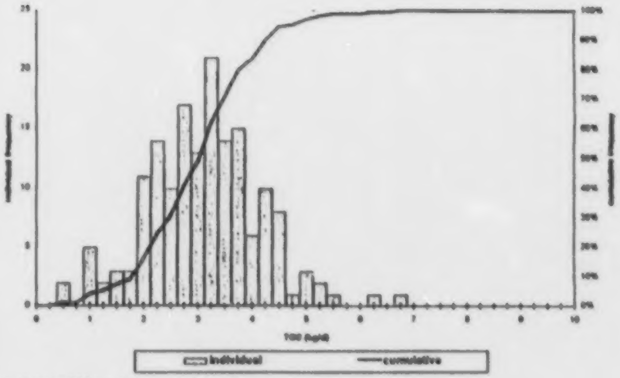
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Frequency Distribution
Celanese (South Flume): 1990-1996



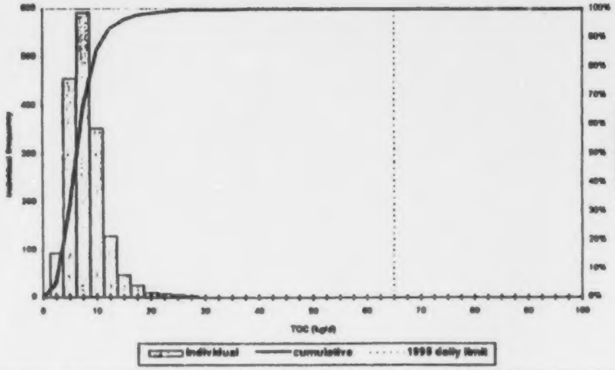
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Frequency Distribution
Dow Chemical Canada: 1990-1995



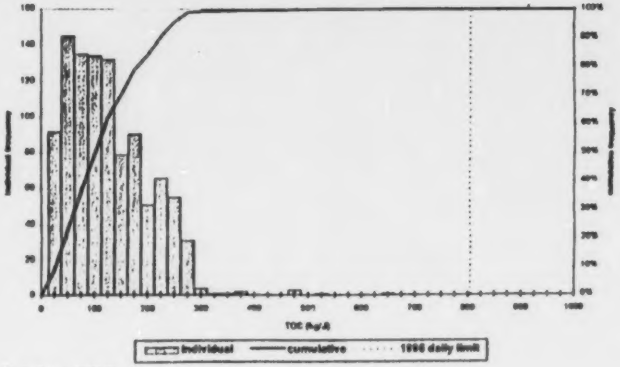
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Frequency Distribution
DuPont Canada: 1991-1995



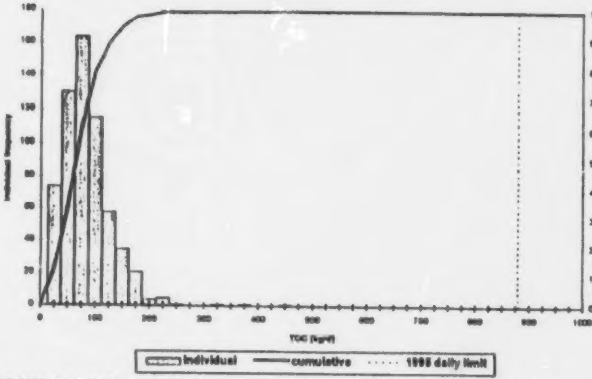
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Frequency Distribution
Geon Canada: 1991-1995



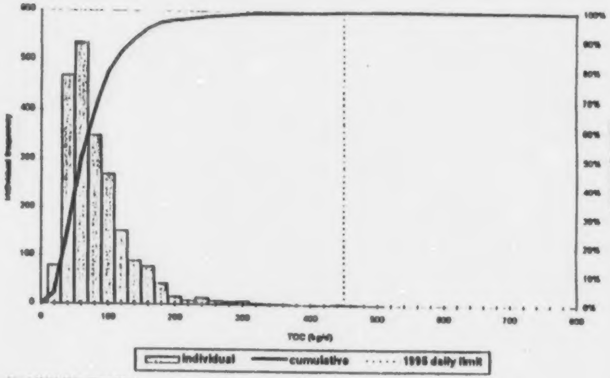
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Frequency Distribution
Nova Chemicals: 1991-1995

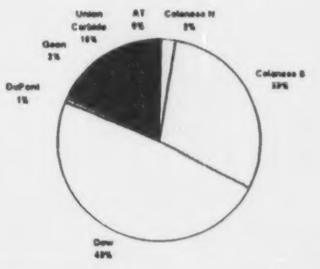


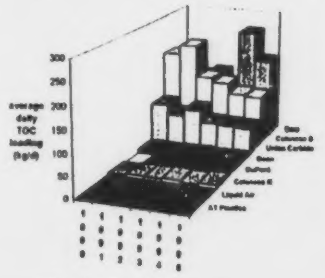
Performance Summary: Chemical Plants
Individual Daily TOC Loading - Frequency Distribution
Shell Canada: 1991-1996



Performance Summary: Chemical Plants
Individual Daily TOC Loading - Frequency Distribution
Union Carbide: 1991-1996




Performance Summary: Chemical Plants
Average Daily TOC Loading for 1995
non-batch facilities only
100% = 387.6 kg/d aggregate TOC loading


Performance Summary: Chemical Plants
Annually Averaged Daily TOC Loading
all plants except Nova & Shell ; 1990-1995

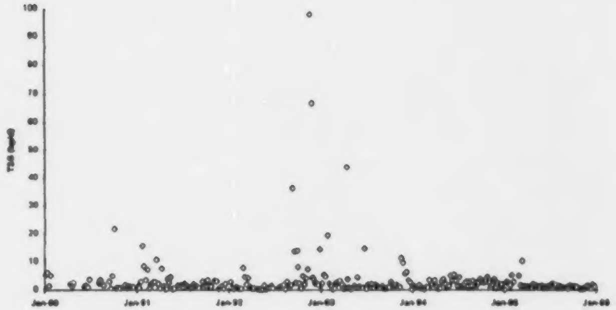
		calculation of aggregate for plants with continuous discharge & absolute measurements only (kg/d):										aggregate (kg/d):
		AT	Liquid Air	Celanese N	Celanese S	Dow	DuPont	Geon	Nova	Shell	Union Carbide	all
mode of operation:		continuous	continuous	continuous	continuous	continuous	continuous	continuous	batch	batch	continuous	
total samples 1990-1995:		177	103	2174	2190	1682	184	1745	1024	612	2167	
average for:	1990	-	-	5.1	207.1	68.0		8.1			98.7	386.9
	1991	-	-	7.2	231.6	137.5	2.9	6.4			77.3	462.8
	1992	2.3	-	6.1	153.1	147.6	2.5	6.8			93.7	412.1
	1993	1.7	0.3	8.2	142.4	118.5	3.0	7.9			65.9	348.0
	1994	1.8	0.2	5.0	119.5	257.3	3.3	6.4			63.3	456.8
	1995	1.3	0.1	8.4	116.5	187.7	4.1	7.3			62.3	387.6
	1990-1995	1.7	0.1	6.7	161.7	153.7	3.3	7.1			76.9	411.2

TOC: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

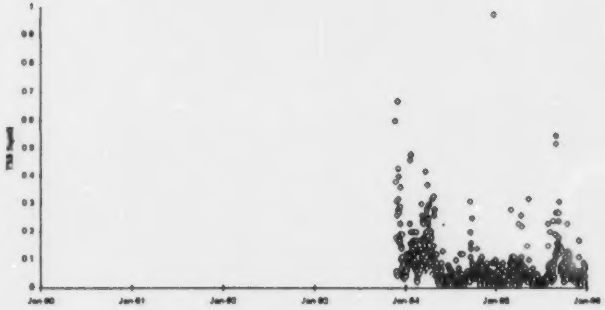
	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
AT	-	-	-	-	2.3	2.6	1.7	2.0	1.8	1.6	1.3	1.3	-	-
Liquid Air	-	-	-	-	-	-	0.3	0.3	0.2	0.1	0.1	0.0	-	-
Celanese N	5.1	6.1	7.2	6.5	6.1	4.0	8.2	6.6	5.0	2.8	8.4	6.8	82	41
Celanese S	207.1	282.6	231.6	332.2	153.1	112.7	142.4	95.1	119.6	78.8	116.5	59.4	2770	1386
Dow	68.0	71.5	137.5	125.0	147.6	140.6	118.5	74.3	257.3	112.5	187.7	99.4	800	400
DuPont			2.9	0.8	2.8	0.7	3.0	1.4	3.3	1.0	4.1	7.1	-	-
Geon	8.1	7.0	6.4	4.0	6.8	3.2	7.9	6.2	6.4	2.9	7.3	4.0	65	22
Nova	-	-	102.6	87.0	95.6	63.4	118.8	73.2	142.7	83.9	120.0	70.2	805	269
Shell	100.6	65.9	75.2	44.2	49.7	28.4	69.6	39.2	77.8	50.7	65.0	39.6	880	440
Union Carbide	98.7	133.0	77.3	54.2	93.7	61.9	65.9	77.4	63.3	34.6	62.3	27.8	450	200

Total Suspended Solids
(TSS)

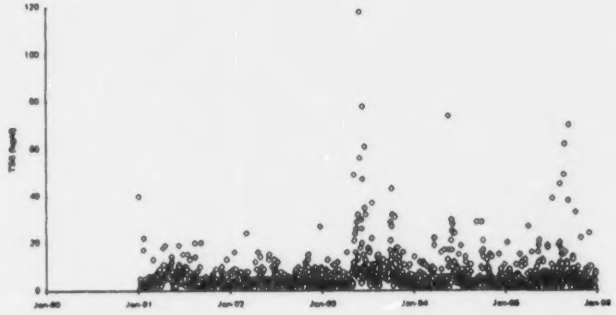
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Time Series
AT Plastics: 1990-1995



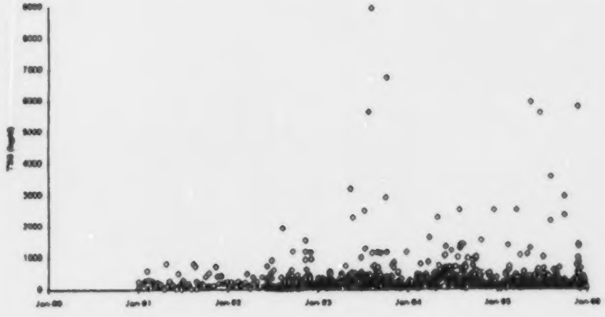
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Time Series
Canadian Liquid Air: 1993-1995



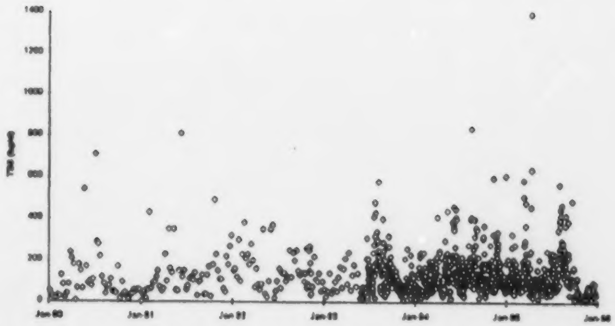
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Time Series
Celanese (North Flume): 1990-1995



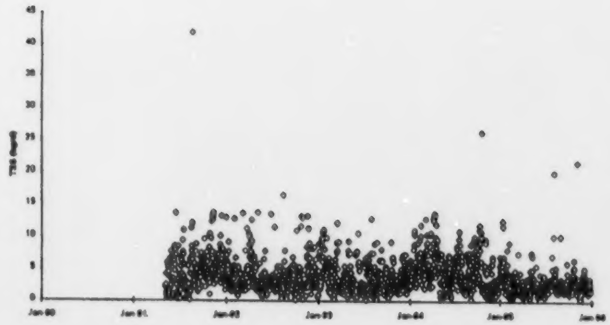
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Time Series
Celanese (South Flume): 1990-1995



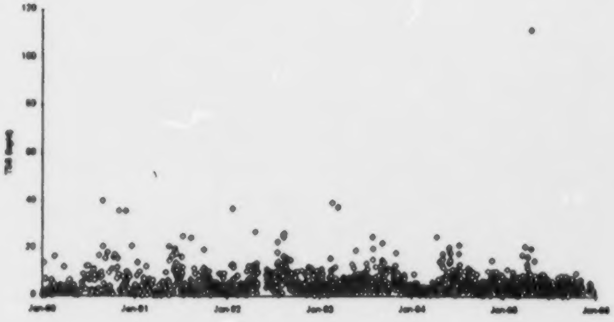
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Time Series
Dow Chemical Canada: 1990-1995



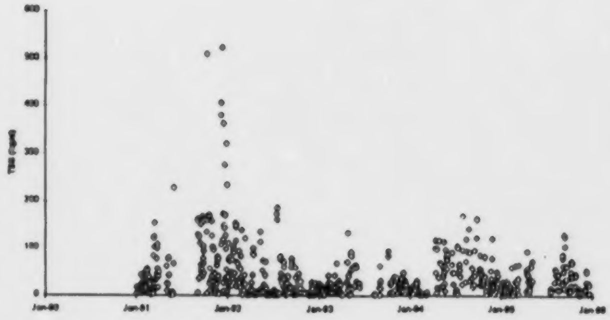
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Time Series
DuPont Canada: 1991-1995



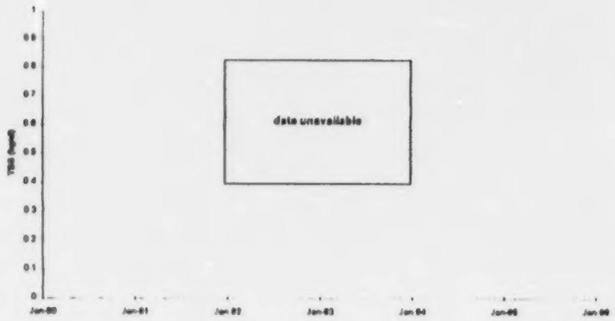
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Time Series
Geon Canada: 1990-1995



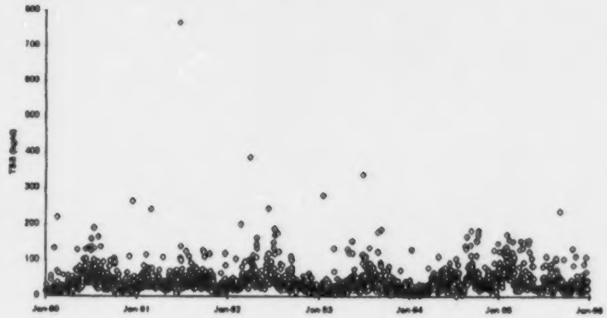
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Time Series
Nova Chemicals: 1990-1995



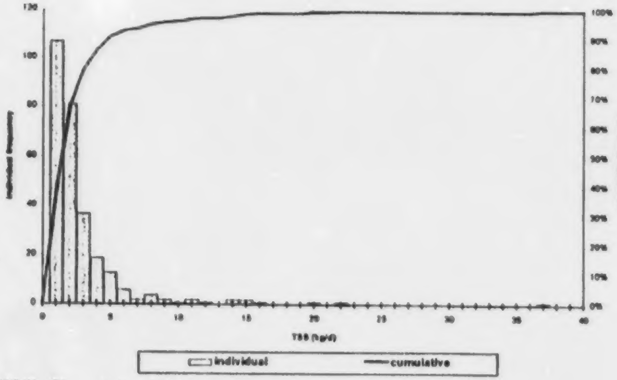
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Time Series
Shell Canada: 1990-1996



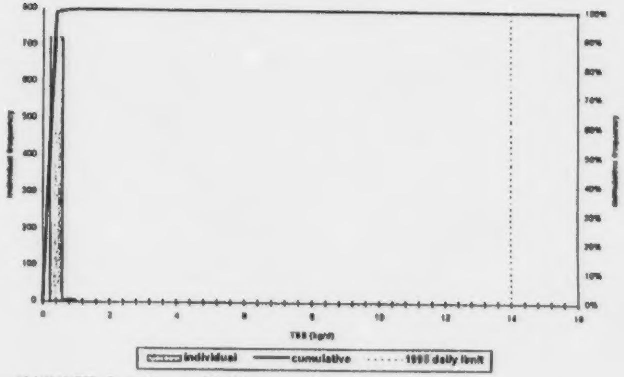
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Time Series
Union Carbide: 1990-1996



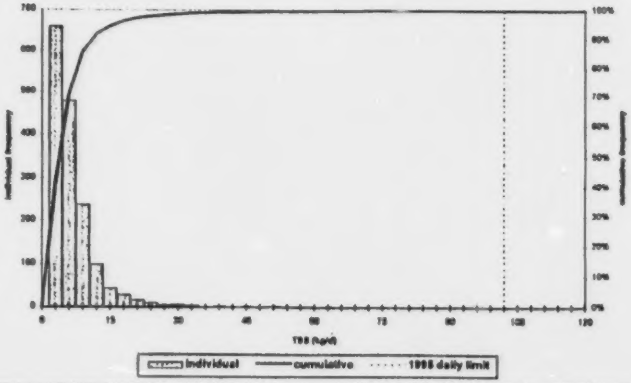
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Frequency Distribution
AT Plastics: 1990-1995



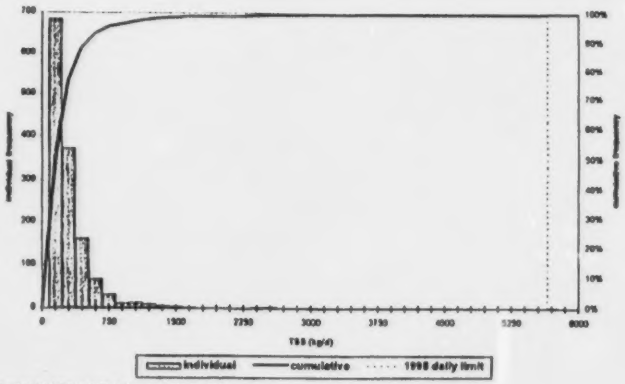
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Frequency Distribution
Canadian Liquid Air: 1993-1995



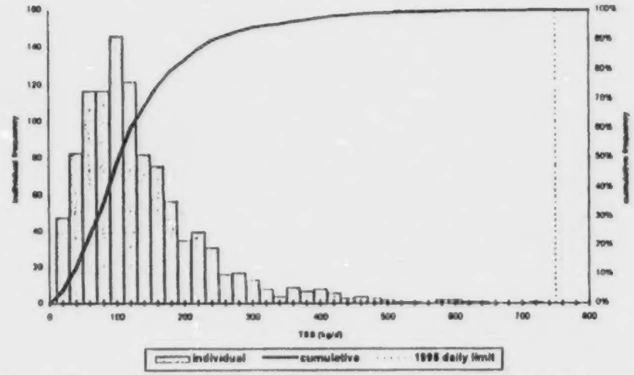
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Frequency Distribution
Celanese (North Flume): 1990-1995



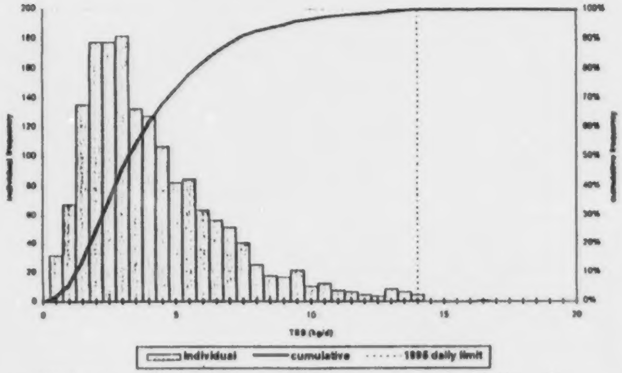
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Frequency Distribution
Celanese (South Flume): 1990-1995



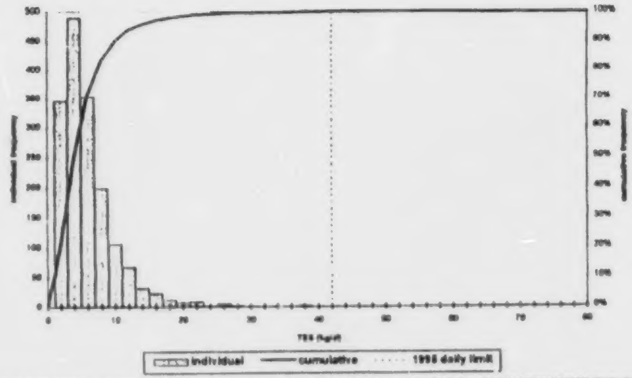
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Frequency Distribution
Dow Chemical Canada: 1990-1996



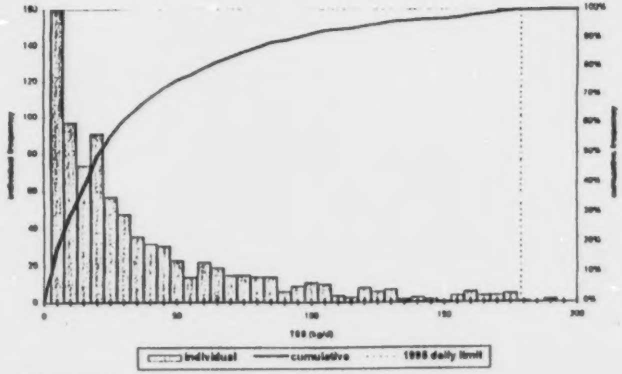
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Frequency Distribution
DuPont Canada: 1991-1996



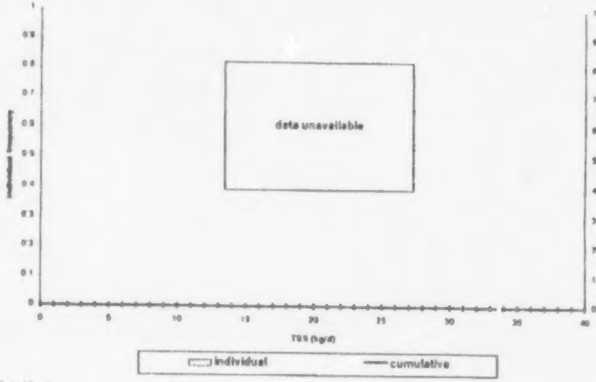
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Frequency Distribution
Geon Canada: 1991-1996



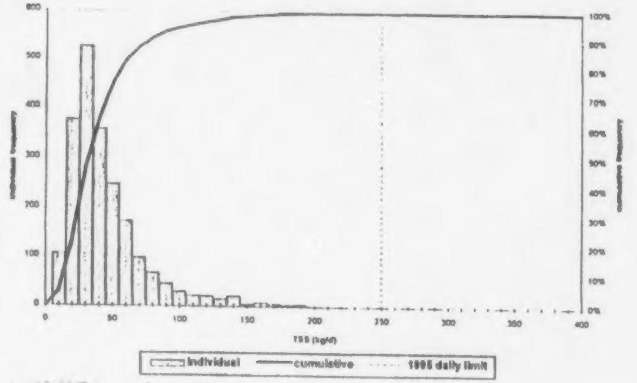
Performance Summary: Chemical Plants
Individual Daily TSS Loading - Frequency Distribution
Nova Chemicals: 1991-1996

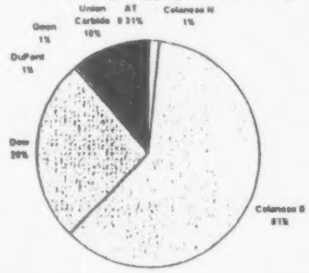


Performance Summary: Chemical Plants
Individual Daily TSS Loading - Frequency Distribution
Shell Canada: 1991-1995

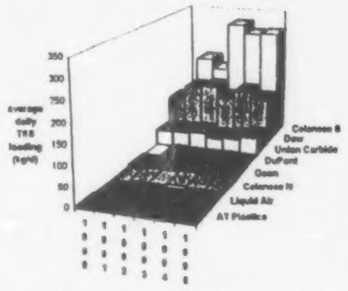


Performance Summary: Chemical Plants
Individual Daily TSS Loading - Frequency Distribution
Union Carbide: 1991-1995





Performance Summary: Chemical Plants
Average Daily TSS Loading for 1995
non-batch facilities only
100% = 485.2 kg/d aggregate TSS loading



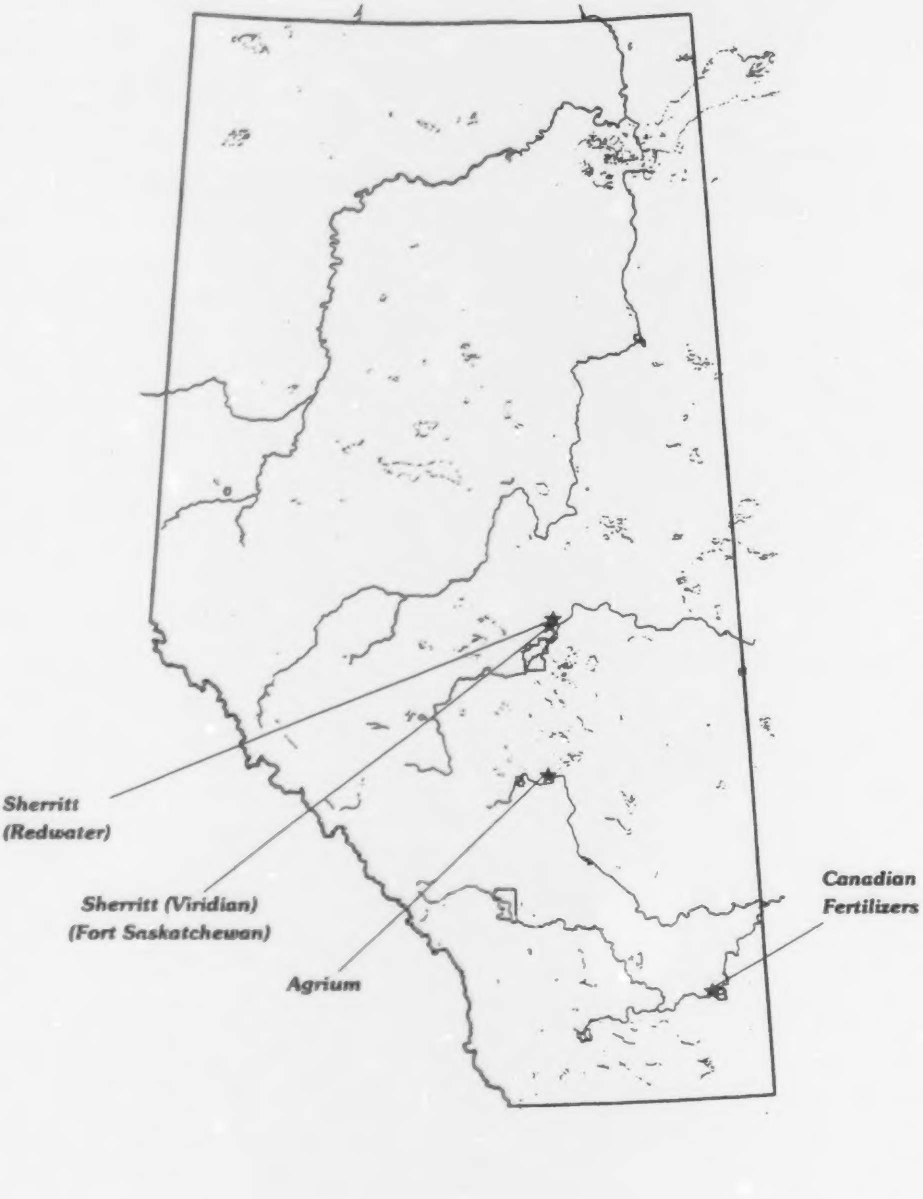
Performance Summary: Chemical Plants
Annually Averaged Daily TSS Loading
all plants except Nova & Shell ; 1990-1995

		calculation of aggregate for plants with continuous discharge & absolute measurements only (kg/d):										aggregate (kg/d):
		AT	Liquid Air	Celanese N	Celanese S	Dow	DuPont	Geon	Nova	Shell	Union Carbide	all
mode of operation:		continuous	continuous	continuous	continuous	continuous	continuous	continuous	batch	batch	continuous	
total samples 1990-1995:		286	731	1612	1388	1066	1681	1666	869	0	2164	
average for:	1990	2.7	-	-	-	107.9		5.5			41.2	157.3
	1991	2.4	-	5.5	208.1	145.8	4.8	5.1			42.2	413.8
	1992	6.2	-	4.5	180.2	162.2	3.8	5.8			44.8	397.6
	1993	3.3	0.2	8.3	316.2	122.3	3.9	5.5			34.6	494.2
	1994	2.0	0.1	5.6	291.9	145.3	4.9	4.6			39.3	493.8
	1995	1.5	0.1	6.0	295.5	127.0	2.8	4.8			47.5	485.2
	1990-1995	3.1	0.1	6.1	276.8	133.5	4.0	5.2			41.6	470.3

TSS: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
AT	2.7	4.0	2.4	2.9	6.2	16.6	3.3	6.7	2.0	1.3	1.5	1.6	30	-
Liquid Air	-	-	-	-	-	-	0.2	0.2	0.1	0.1	0.1	0.1	14	7
Celanese N	-	-	5.5	4.6	4.5	3.4	8.3	10.6	5.6	6.2	6.0	7.5	102	102
Celanese S	-	-	208.1	197.1	180.2	244.9	316.2	714.6	291.9	321.1	295.5	618.5	5652	2826
Dow	107.9	126.5	145.8	138.7	162.2	89.8	122.3	91.0	145.3	97.3	127.0	126.5	750	400
DuPont			4.8	3.7	3.8	2.6	3.9	2.3	4.9	3.0	2.8	2.2	14	7
Geon	5.5	6.7	5.1	4.4	5.8	4.9	5.5	4.4	4.6	3.8	4.8	5.9	42	42
Nova	-	-	66.5	85.6	29.3	38.8	26.6	22.7	46.2	40.2	30.3	27.6	179	638
Shell	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Union Carbide	41.2	33.0	42.2	45.1	44.8	38.5	34.6	34.5	39.3	32.3	47.5	38.3	250	100

Fertilizer Plants


Sherritt
(Redwater)
Sherritt (Viridian)
(Fort Saskatchewan)
Agrium
Canadian
Fertilizers

Fertilizer Plants

General

There are currently fifteen fertilizer plants in Alberta, of which four are approved for direct discharge. Sherritt Incorporated, based in Fort Saskatchewan, produces granulated phosphate, phosphoric acid, anhydrous ammonia and urea. It also includes a metals operation and a chemical plant on-site. Sherritt's Redwater plant, a plant formerly operated by Imperial Oil's Esso Chemical Division, produces granulated phosphate, phosphoric acid, anhydrous ammonia and urea. The Canadian Fertilizers plant at Medicine Hat produces two nitrogen-based fertilizer products, while The Agrium plant at Joffre produces only liquid anhydrous ammonia. It should be noted that Agrium's limit for ammonia-N is imposed by AEP in mg/l and not in kg/d.

Fertilizer Plants General Information

plant	receiving stream	location	opened
Sherritt	North Saskatchewan River	Fort Saskatchewan	pre-1990
Sherritt	North Saskatchewan River	Redwater	pre-1990
Agrium	Red Deer River	Joffre	pre-1990
Canadian Fertilizers	South Saskatchewan River	Medicine Hat	pre-1990

Monitoring

Fifteen separate discharge monitoring requirements have been defined for this sector, of which five are included in this report: organic nitrogen, ammonia-N, phosphate, TSS & flow. The imposed effluent discharge limits for each of these plants are summarized in the following table:

Fertilizer Plants Mandated Effluent Limits

plant	parameter	1995 daily limit (kg/d)	1995 monthly limit (kg/d)
Sherritt* (Fort Saskatchewan)	organic nitrogen	852 (net)	284 (net)
	ammonia-N	1515 (net)	505 (net)
	phosphate	132 (net)	44 (net)

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* Pursuant to the terms of its discharge approval, Sherritt (Fort Saskatchewan) reports its effluent monitoring data as net mass loadings (kg/d), *not* as absolute mass loadings (kg/d).

plant	parameter	1995 daily limit (kg/d)	1995 monthly limit (kg/d)
	TSS	1587 (net)	529 (net)
Sherritt (Redwater)	organic nitrogen	356	119
	ammonia-N	1245	415
	phosphate	287	93
	TSS	888	296
Agrium[*]	organic nitrogen	-	-
	ammonia-N	30 mg/l	-
	phosphate	-	-
	TSS	45 mg/l	-
Canadian Fertilizers	organic nitrogen	300	80
	ammonia-N	700	170
	phosphate	100	20
	TSS	500	150

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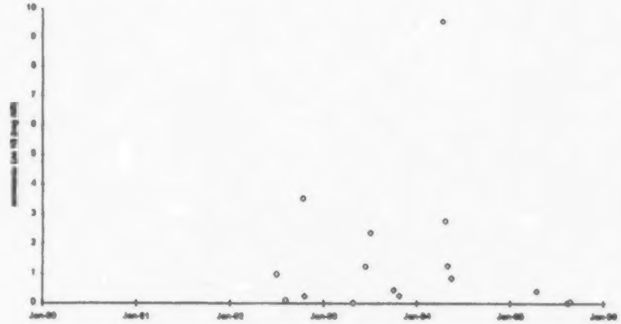
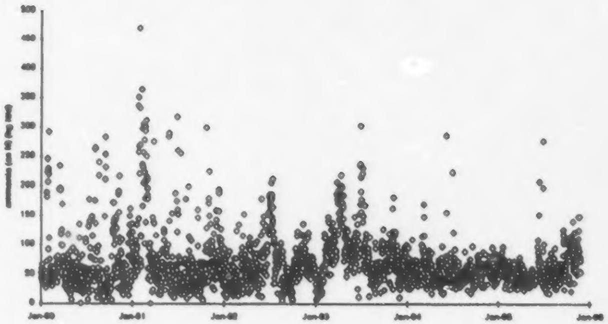
[*] batch operation

Ammonia

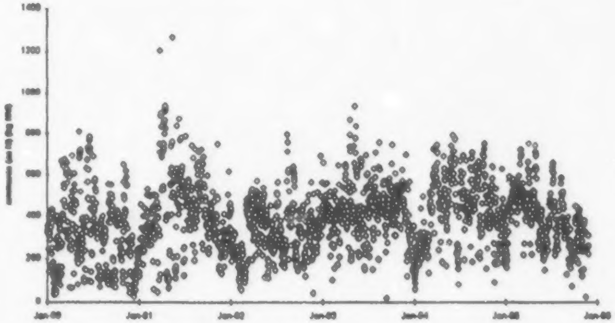
Performance Summary: Fertilizer Plants
Individual Daily Ammonia Loading - Time Series (in mg N/l)
Agrium Incorporated: 1992-1995



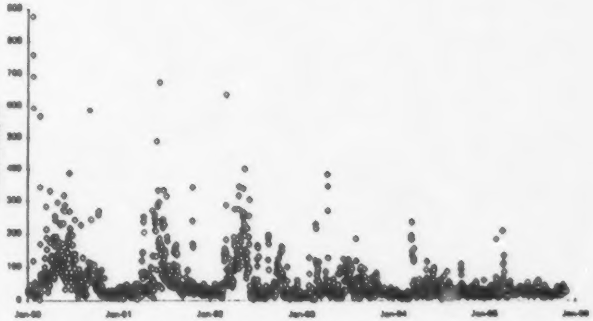
Performance Summary: Fertilizer Plants
Individual Daily Ammonia Loading - Time Series
Canadian fertilizers Limited: 1990-1995



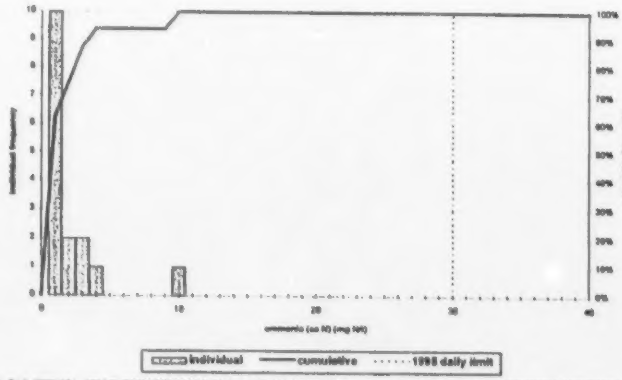
Performance Summary: Fertilizer Plants
Individual Daily Ammonia Loading - Time Series
Sherritt (Ft Saskatchewan): 1990-1995



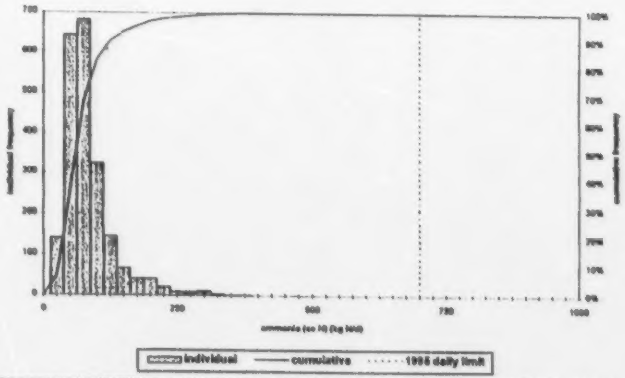
Performance Summary: Fertilizer Plants
Individual Daily Ammonia Loading - Time Series
Sherritt (Redwater): 1990-1995



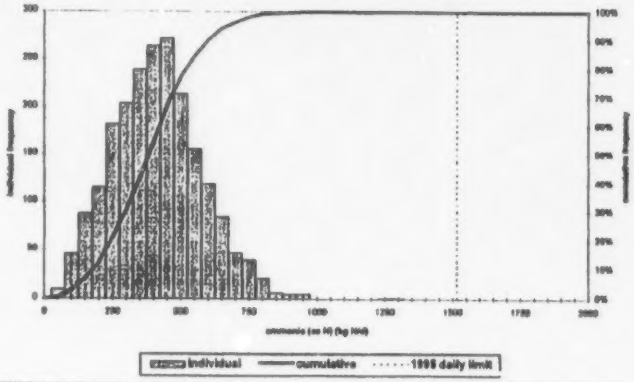
Performance Summary: Fertilizer Plants
Individual Daily Ammonia Loading - Frequency Distribution (in mg N/l)
Agrium: 1992-1995



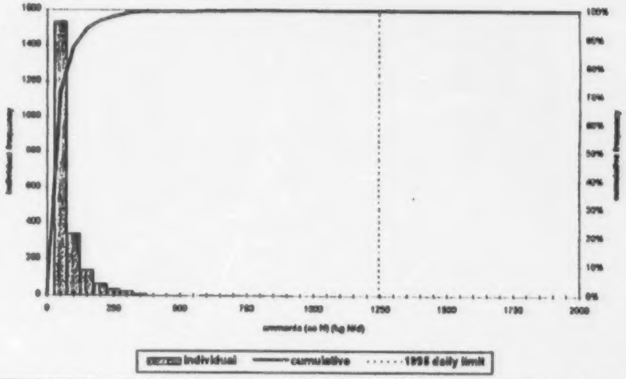
Performance Summary: Fertilizer Plants
Individual Daily Ammonia Loading - Frequency Distribution
Canadian Fertilizers: 1990-1995



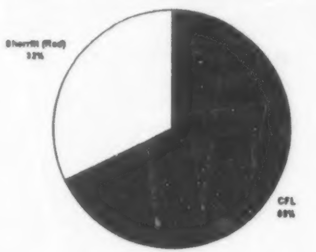
Performance Summary: Fertilizer Plants
Individual Daily Ammonia Loading - Frequency Distribution
Sherritt (Ft Saskatchewan): 1990-1995



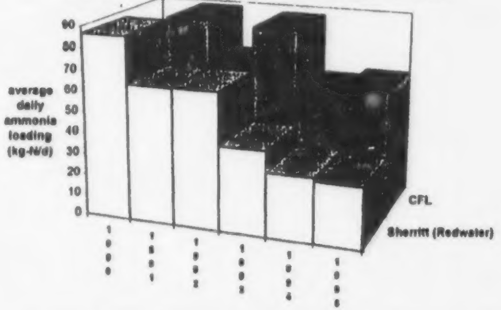
Performance Summary: Fertilizer Plants
Individual Daily Ammonia Loading - Frequency Distribution
Sherritt (Redwater): 1990-1995



Performance Summary: Fertilizer Plants
Average Daily Ammonia Loading for 1995
non-batch and non-net facilities only
100% = 89.3 kg-N/d aggregate ammonia loading



Performance Summary: Fertilizer Plants
Annually Averaged Daily Ammonia Loading
all plants except Agrium & Sherritt (Ft Sask) ; 1990-1995



		calculation of aggregate (non-batch and non-net facilities only) (kg N/d):				
		Agrium	CFL	herritt (Ft.Sas	Sherritt (Red)	aggregate
mode of operation:		batch	continuous	continuous	continuous	
total samples 1990-1995:		0	384	2121	2169	
average for:	1990		71.0		86.7	157.7
	1991		87.7		64.8	152.5
	1992		66.3		65.0	131.3
	1993		86.1		40.2	126.3
	1994		57.5		30.3	87.8
	1995		60.6		28.7	89.3
	1990-1995		71.7		53.0	124.7

note:

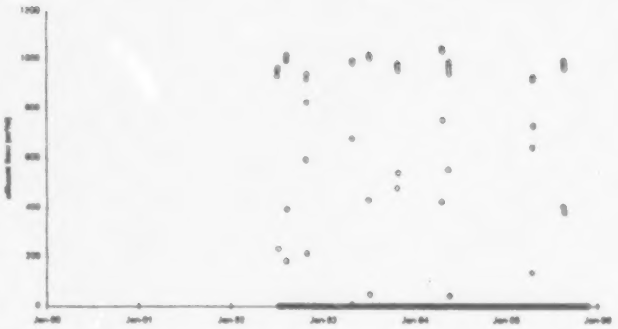
Sherritt (Ft Sask) reports NET values

ammonia (as N): calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

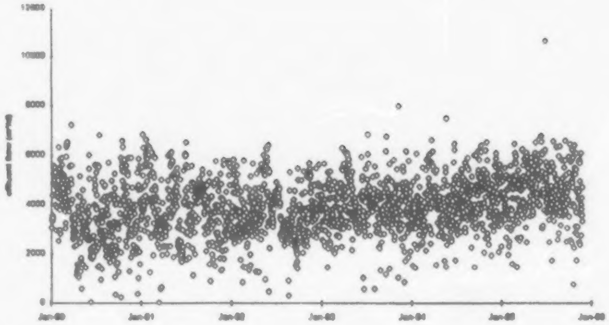
	1990		1991		1992		1993		1994		1995		1995 imposed limits:	
plant	x (kg N/d)	s (kg N/d)	x (kg N/d)	s (kg N/d)	x (kg N/d)	s (kg N/d)	x (kg N/d)	s (kg N/d)	x (kg N/d)	s (kg N/d)	x (kg N/d)	s (kg N/d)	daily	monthly
Agrium	-	-	-	-	-	-	0.9	1.3	1.5	0.9	-	-	30 mg/l	-
CFL	71.0	55.3	87.7	74.1	66.3	37.5	86.1	46.1	57.5	25.4	60.6	28.6	700 kg/d	170 kg/d
Sherritt (Ft Sask)	317.9	174.0	425.3	187.8	330.6	126.6	434.6	134.9	431.7	102.5	392.2	130.6	1515 kg/d	505 kg/d
Sherritt (Red)	86.7	102.7	64.8	75.5	65.0	75.3	40.2	41.6	30.3	29.1	28.7	22.2	1245 kg/d	415 kg/d

Effluent Flow

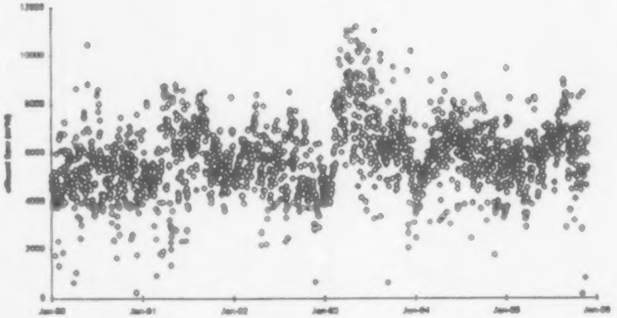
Performance Summary: Fertilizer Plants
Individual Daily Effluent Flow - Time Series
Agrium Incorporated: 1992-1995



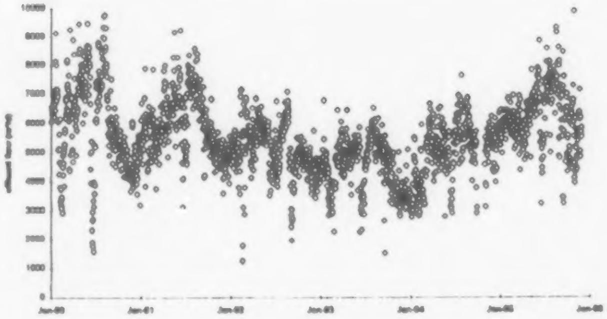
Performance Summary: Fertilizer Plants
Individual Daily Effluent Flow - Time Series
Canadian fertilizers Limited: 1990-1995



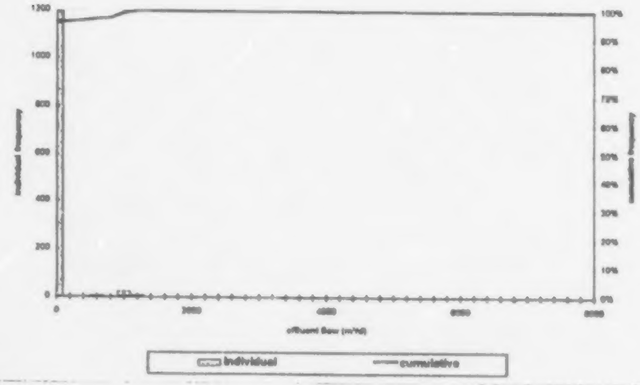
Performance Summary: Fertilizer Plants
Individual Daily Effluent Flow - Time Series
Sherritt (Ft Saskatchewan): 1990-1995



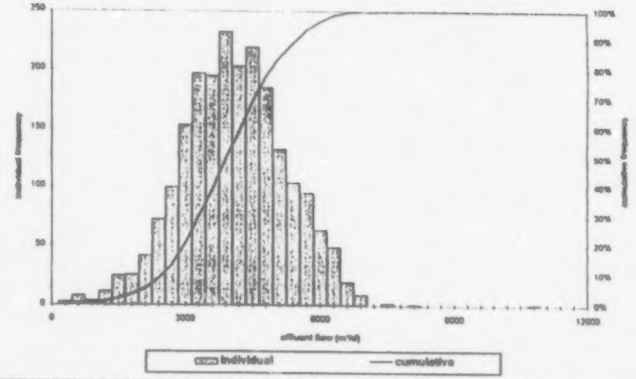
Performance Summary: Fertilizer Plants
Individual Daily Effluent Flow - Time Series
Sherritt (Redwater): 1990-1995



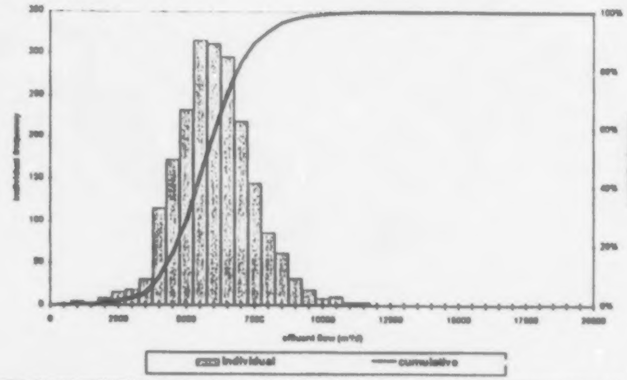
Performance Summary: Fertilizer Plants
Individual Daily Effluent Flow - Frequency Distribution
Agrium: 1992-1996



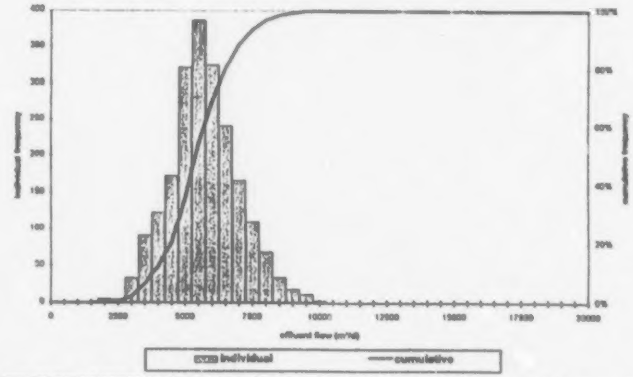
Performance Summary: Fertilizer Plants
Individual Daily Effluent Flow - Frequency Distribution
Canadian Fertilizers: 1990-1996



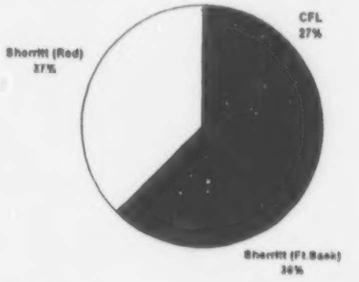
Performance Summary: Fertilizer Plants
Individual Daily Effluent Flow - Frequency Distribution
Sherritt (Ft Saskatchewan): 1990-1996



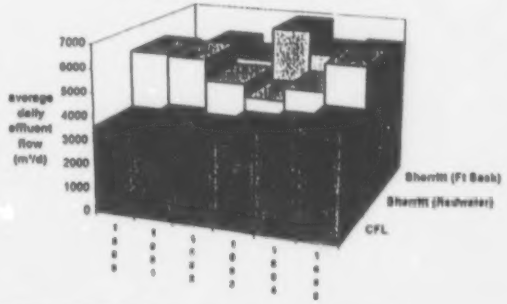
Performance Summary: Fertilizer Plants
Individual Daily Effluent Flow - Frequency Distribution
Sherritt (Redwater): 1990-1996



Performance Summary: Fertilizer Plants
Average Daily Effluent Flow for 1995
non-batch facilities only
100% = 16667.2 m³/d aggregate effluent flow



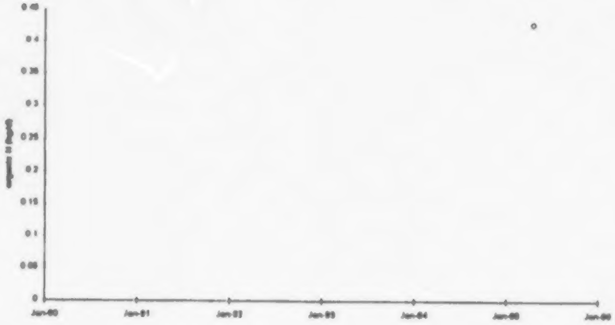
Performance Summary: Fertilizer Plants
Annually Averaged Daily Effluent Flow
all plants except Agrium ; 1990-1995



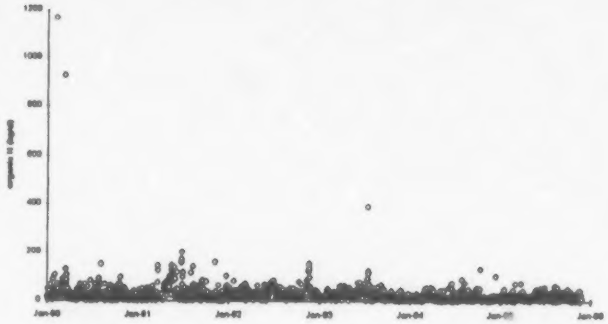
		calculation of aggregate (non-batch facilities only) (m³/d):				
		Agrium	CFL	herritt (Ft.Sas	Sherritt (Red)	aggregate
mode of operation:		batch	continuous	continuous	continuous	
total samples 1990-1995:		0	364	2122	2129	
average for:	1990		3597.4	5058.5	6038.6	14694.5
	1991		3851.4	5771.7	5962.7	15585.7
	1992		3626.5	5345.1	5057.2	14028.8
	1993		3916.9	6772.8	4484.3	15174.0
	1994		4099.8	5811.3	5024.2	14935.3
	1995		4507.6	5927.0	6232.6	16667.2
	1990-1995		3925.1	5777.4	5461.7	15164.3

Organic Nitrogen

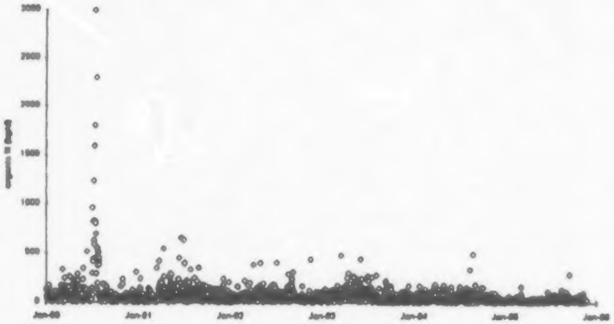
Performance Summary: Fertilizer Plants
Individual Daily Organic Nitrogen Loading - Time Series
Agrium Incorporated: 1992-1996



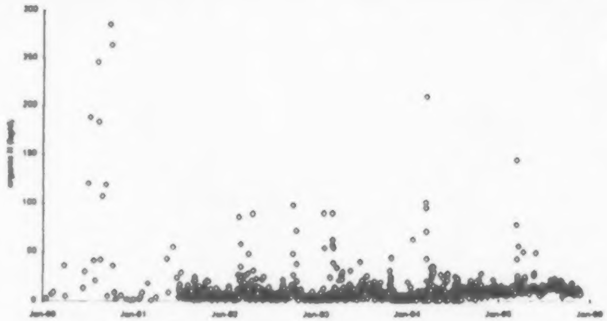
Performance Summary: Fertilizer Plants
Individual Daily Organic Nitrogen Loading - Time Series
Canadian fertilizers Limited: 1990-1996



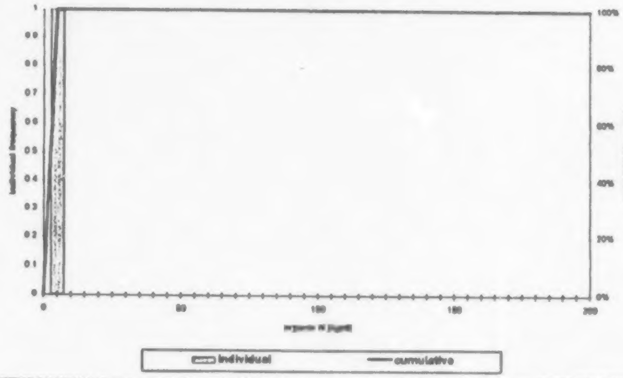
Performance Summary: Fertilizer Plants
Individual Daily Organic Nitrogen Loading - Time Series
Sherritt (Ft Saskatchewan): 1990-1996



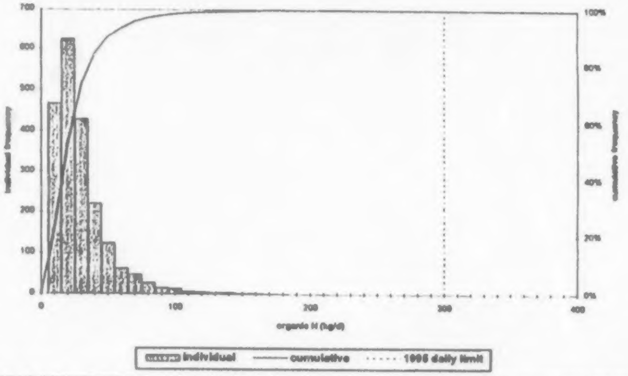
Performance Summary: Fertilizer Plants
Individual Daily Organic Nitrogen Loading - Time Series
Sherritt (Redwater): 1990-1996



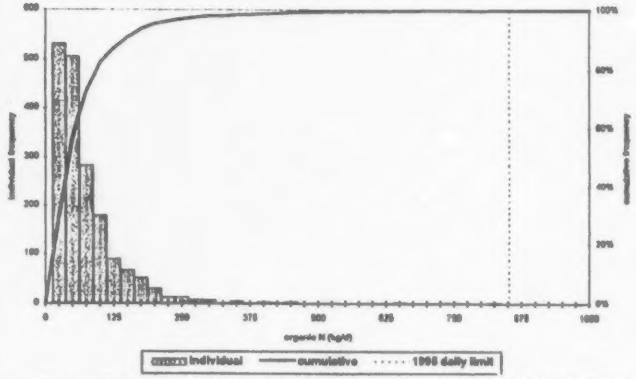
Performance Summary: Fertilizer Plants
Individual Daily Organic Nitrogen Loading - Frequency Distribution
Agrium: 1992-1995



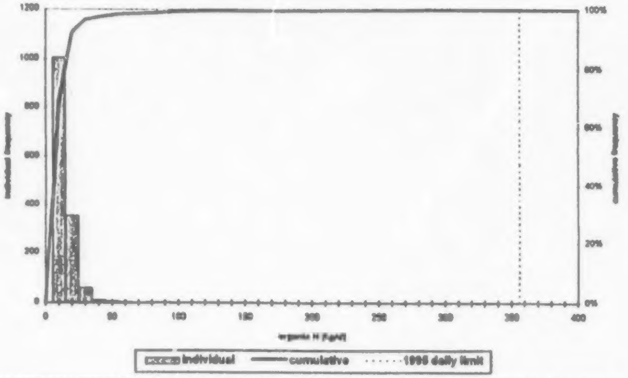
Performance Summary: Fertilizer Plants
Individual Daily Organic Nitrogen Loading - Frequency Distribution
Canadian Fertilizers: 1990-1995

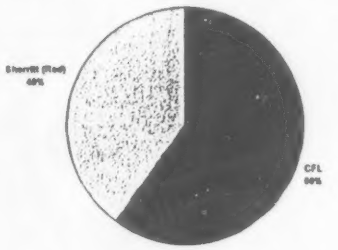


Performance Summary: Fertilizer Plants
Individual Daily Organic Nitrogen Loading - Frequency Distribution
Sherritt (Ft Saskatchewan): 1990-1995



Performance Summary: Fertilizer Plants
Individual Daily Organic Nitrogen Loading - Frequency Distribution
Sherritt (Redwater): 1990-1995



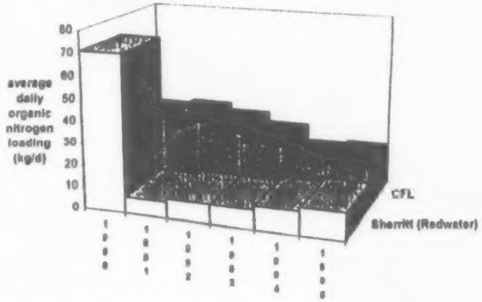


Performance Summary: Fertilizer Plants

Average Daily Organic Nitrogen Loading for 1995

non-batch & non-net facilities only

100% = 31.0 kg/d aggregate organic nitrogen loading



Performance Summary: Fertilizer Plants

Annually Averaged Daily Organic Nitrogen Loading

all plants except Agrium & Sherritt (Ft Sask) ; 1990-1995

calculation of aggregate (non-batch and non-net facilities only) (kg/d):

		Agrium	CFL	Sherritt (Ft.Sask)	Sherritt (Red)	aggregate
mode of operation:		batch	continuous	continuous	continuous	
total samples 1990-1995:		1	2074	1834	1475	
average for:	1990		31.0		71.2	102.2
	1991		32.7		7.5	40.2
	1992		29.4		8.9	38.4
	1993		25.0		8.8	33.8
	1994		17.4		10.7	28.0
	1995		18.6		12.4	31.0
	1990-1995		25.8		11.0	36.8

note:

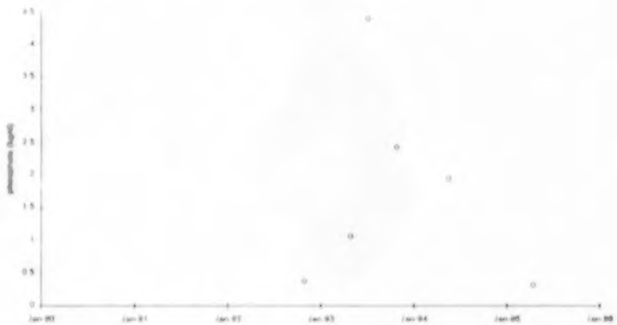
Sherritt (Ft. Sask) reports NET values

organic nitrogen: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

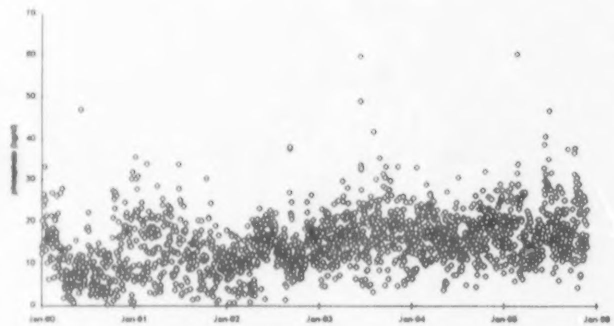
plant	1990 x (kg/d)	s (kg/d)	1991 x (kg/d)	s (kg/d)	1992 x (kg/d)	s (kg/d)	1993 x (kg/d)	s (kg/d)	1994 x (kg/d)	s (kg/d)	1995 x (kg/d)	s (kg/d)	1996 imposed limits (kg/d): daily	monthly
Agrium	-	-	-	-	-	-	-	-	-	-	0.4	-	-	-
CFL	31.0	81.2	32.7	33.9	29.4	19.7	25.0	26.0	17.4	15.9	18.6	12.7	300	80
Sherritt (Ft Sask)	129.2	289.6	92.0	98.4	61.4	61.2	72.6	66.3	60.9	49.9	31.7	27.7	852	284
Sherritt (Red)	71.2	91.6	7.5	7.1	8.9	11.8	8.8	11.0	10.7	14.7	12.4	9.8	356	119

Phosphate

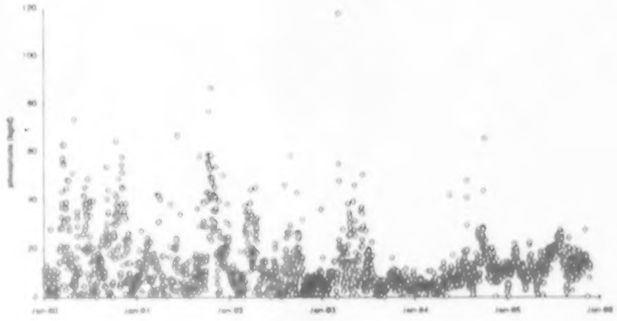
Performance Summary: Fertilizer Plants
Individual Daily Phosphate Loading - Time Series
Agrium Incorporated: 1992-1995



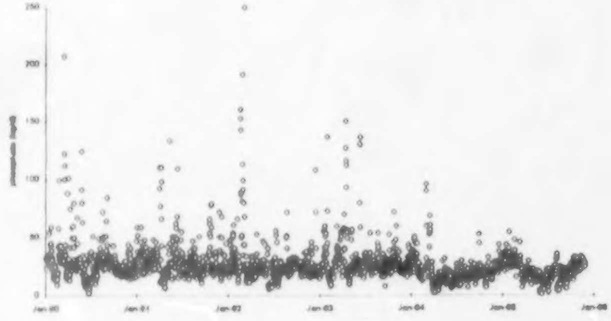
Performance Summary: Fertilizer Plants
Individual Daily Phosphate Loading - Time Series
Canadian Fertilizers Limited: 1990-1995



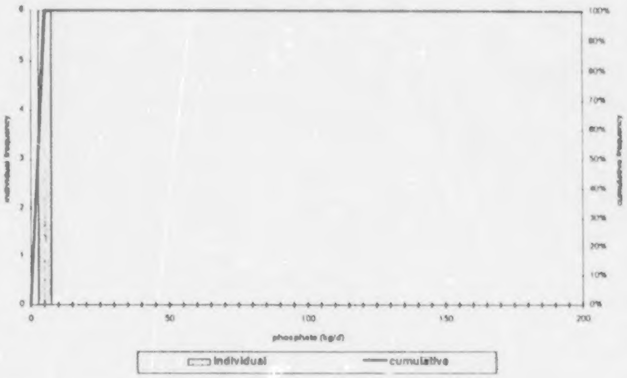
Performance Summary: Fertilizer Plants
Individual Daily Phosphate Loading - Time Series
Sherritt (Ft Saskatchewan): 1990-1995



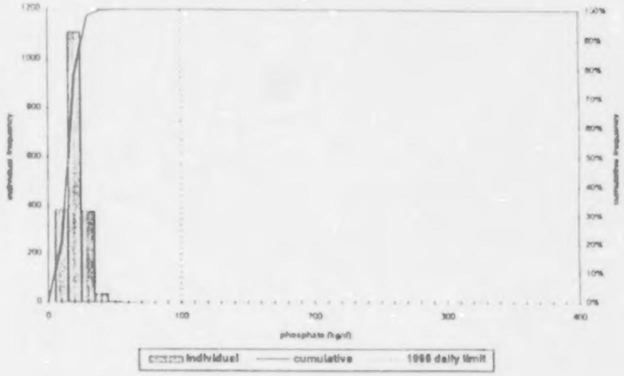
Performance Summary: Fertilizer Plants
Individual Daily Phosphate Loading - Time Series
Sherritt (Redwater): 1990-1995



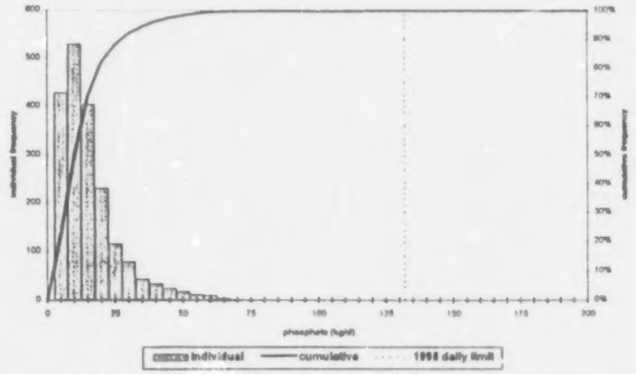
Performance Summary: Fertilizer Plants
Individual Daily Phosphate Loading - Frequency Distribution
Agrium: 1992-1996



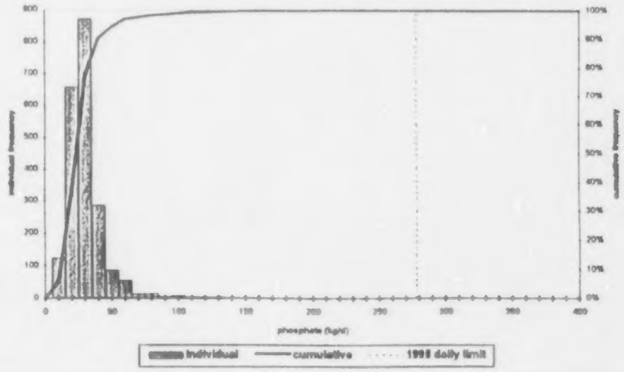
Performance Summary: Fertilizer Plants
Individual Daily Phosphate Loading - Frequency Distribution
Canadian Fertilizers: 1990-1995



Performance Summary: Fertilizer Plants
Individual Daily Phosphate Loading - Frequency Distribution
Sherritt (Ft Saskatchewan): 1990-1996



Performance Summary: Fertilizer Plants
Individual Daily Phosphate Loading - Frequency Distribution
Sherritt (Redwater): 1990-1995



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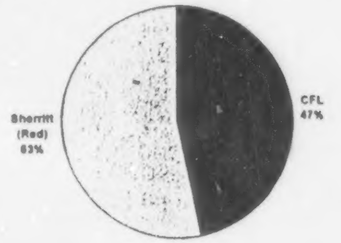
Performance Summary: Fertilizer Plants

Average Daily Phosphate Loading for 1995

non-batch & non-net facilities only

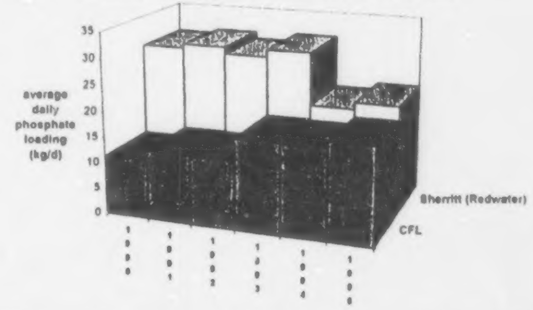
100% = 39.7 kg/d aggregate organic nitrogen loading



Performance Summary: Fertilizer Plants

Annually Averaged Daily Phosphate Loading

all plants except Agrium & Sherritt (Ft Sask); 1990-1995



calculation of aggregate (non-batch and non-net facilities only) (kg/d):

		Agrium	CFL	Sherritt (Ft Sask)	Sherritt (Red)	aggregate
mode of operation:		batch	continuous	continuous	continuous	
total samples 1990-1995:		6	1918	1944	2160	
average for:	1990		11.4		29.3	40.6
	1991		13.2		30.0	43.2
	1992		13.1		28.6	41.7
	1993		17.3		30.1	47.4
	1994		17.1		19.9	37.0
	1995		18.5		21.2	39.7
	1990-1995		15.4		26.6	42.0

note:

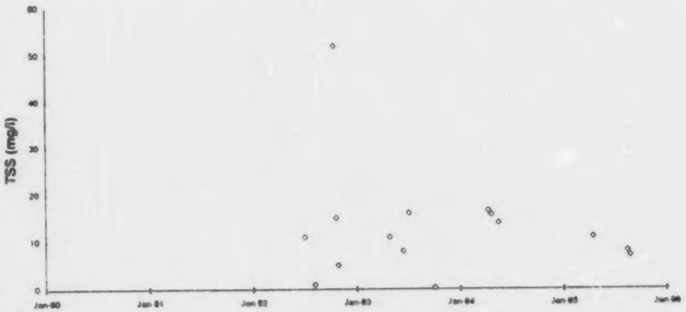
Sherritt (Ft Sask) reports NET values

phosphate: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

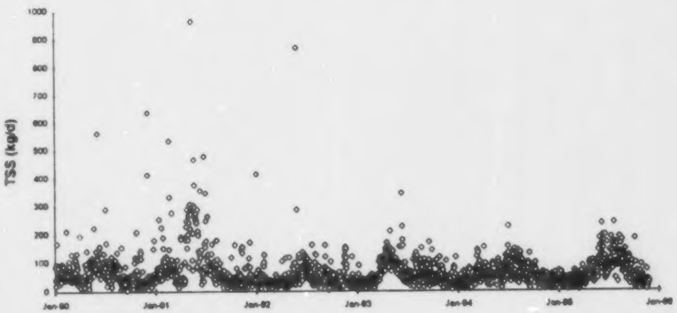
	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Agrium	-	-	-	-	0.4	-	2.6	1.7	1.9	-	0.3	-	-	-
CFL	11.4	7.1	13.2	8.7	13.1	6.1	17.3	8.4	17.1	6.0	18.5	7.1	100	20
Sherritt (Ft Sask)	17.9	15.4	17.6	15.0	11.2	9.7	10.4	10.5	9.8	7.5	13.6	5.4	132	44
Sherritt (Red)	29.3	19.0	30.0	16.6	28.6	23.3	30.1	18.3	19.9	11.1	21.2	8.8	278	93

Total Suspended Solids
(TSS)

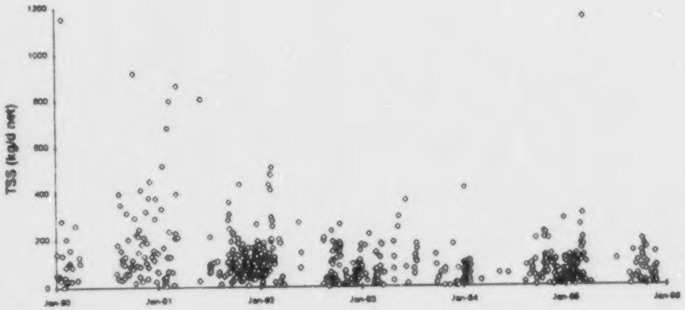
Performance Summary: Fertilizer Plants
Individual Daily TSS Loading - Time Series (in mg/l)
Agrium Incorporated: 1992-1995



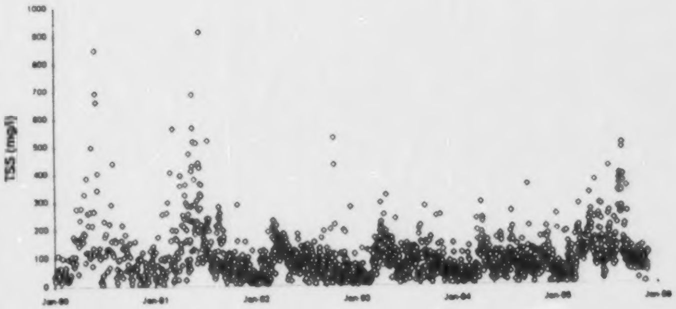
Performance Summary: Fertilizer Plants
Individual Daily TSS Loading - Time Series
Canadian Fertilizers Limited: 1990-1995



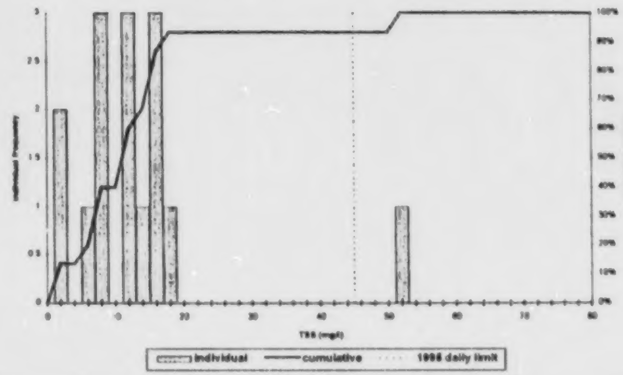
Performance Summary: Fertilizer Plants
Individual Daily TSS Loading - Time Series
Sherritt (Ft Saskatchewan): 1990-1995



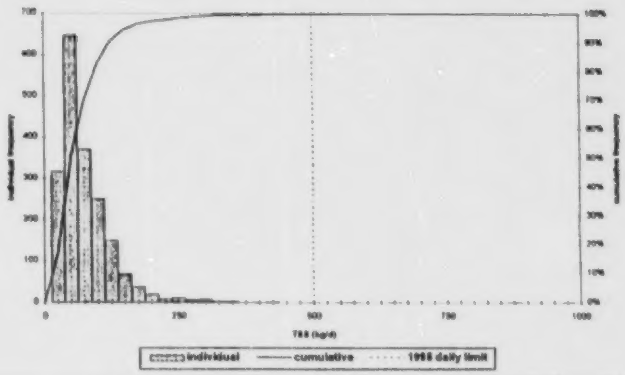
Performance Summary: Fertilizer Plants
Individual Daily TSS Loading - Time Series
Sherritt (Redwater): 1990-1995



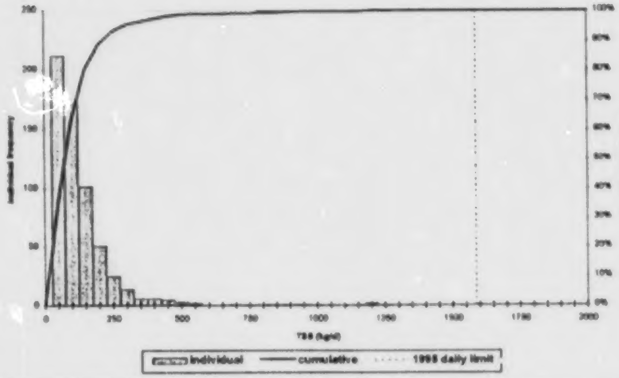
Performance Summary: Fertilizer Plants
Individual Daily TSS Loading - Frequency Distribution (in mg/l)
Agrium: 1992-1996



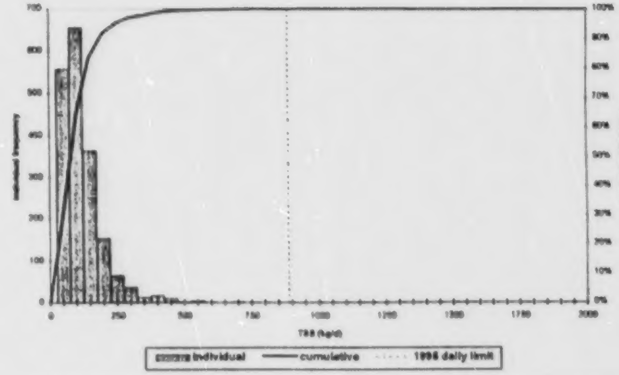
Performance Summary: Fertilizer Plants
Individual Daily TSS Loading - Frequency Distribution
Canadian Fertilizers: 1990-1996



Performance Summary: Fertilizer Plants
Individual Daily TSS Loading - Frequency Distribution
Sherritt (Ft Saskatchewan): 1990-1996



Performance Summary: Fertilizer Plants
Individual Daily TSS Loading - Frequency Distribution
Sherritt (Redwater): 1990-1996

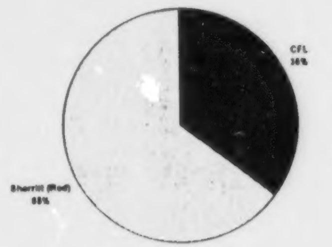


Performance Summary: Fertilizer Plants

Average Daily TSS Loading for 1995

non-batch and non-net facilities only

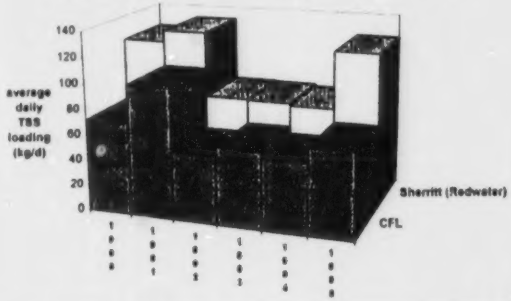
100% = 187.9 kg/d aggregate TSS loading



Performance Summary: Fertilizer Plants

Annually Averaged Daily TSS Loading

all plants except Agrium & Sherritt (Ft Sask) ; 1990-1995



calculation of aggregate (non-batch and non-net facilities only) (kg/d):

		Agrium	CFL	Sherritt (Ft Sask)	Sherritt (Red)	aggregate
mode of operation:		batch	continuous	continuous	continuous	
total samples 1990-1995:		6	1919	604	1891	
average for:	1990		72.0		121.0	192.9
	1991		101.7		129.8	231.5
	1992		52.6		78.8	131.4
	1993		59.9		78.3	138.1
	1994		54.4		76.5	130.9
	1995		66.2		121.7	187.9
	1990-1995		65.9		97.6	163.5

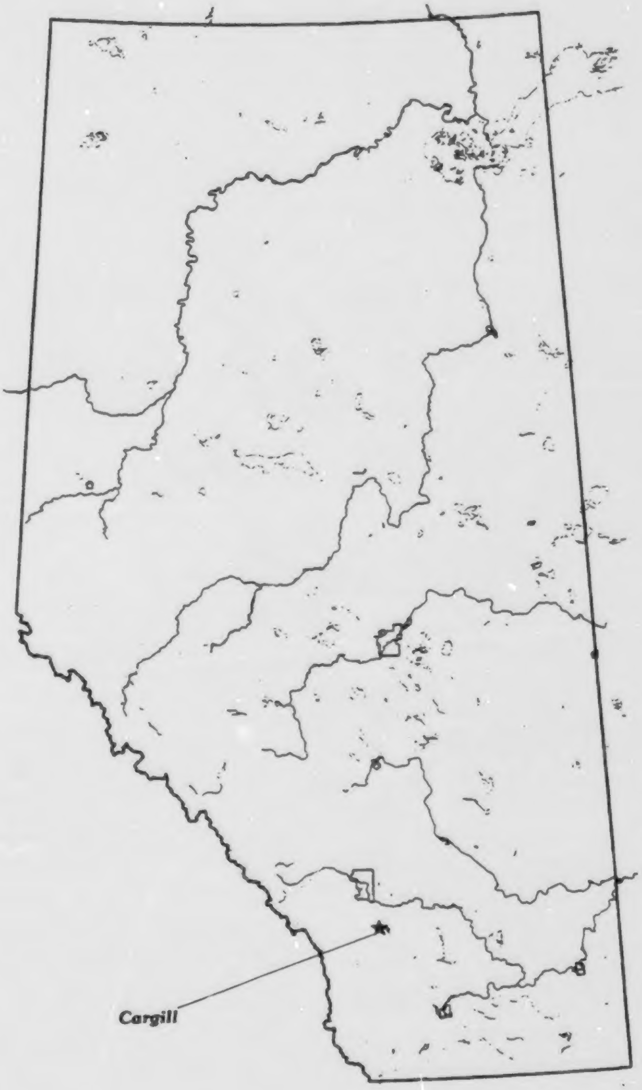
note:

Sherritt (Ft Sask) reports NET values

TSS: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

plant	1990 x (kg/d)	s (kg/d)	1991 x (kg/d)	s (kg/d)	1992 x (kg/d)	s (kg/d)	1993 x (kg/d)	s (kg/d)	1994 x (kg/d)	s (kg/d)	1995 x (kg/d)	s (kg/d)	1996 imposed limits: daily	monthly
Agrium	-	-	-	-	4.6	-	11.9	6.2	12.7	1.4	1.5	-	45 mg/l	-
CFL	72.0	67.2	101.7	105.0	52.6	60.2	59.9	42.2	54.4	31.9	66.2	45.2	500 kg/d	150 kg/d
Sherritt (Ft Sask)	160.5	182.7	130.9	140.9	101.5	97.3	81.7	76.7	73.2	68.1	78.8	121.8	1587 kg/d	529 kg/d
Sherritt (Red)	121.0	123.9	129.8	122.7	78.8	58.1	78.3	53.0	76.5	49.9	121.7	86.2	888 kg/d	296 kg/d

Meat Processing Plants



Meat Processing Plants

General

Alberta has three major types of meat-processing industries, red meat processors, poultry plants and fish processing plants. There are currently twenty seven meat processing plants in Alberta. The two largest plants are Lakeside Packers located at Brooks, and Cargill Foods located at High River[*]. All of Lakeside's wastewater is currently applied toward irrigation of adjacent croplands, thereby eliminating the need to discharge to a receiving watercourse. While some of Cargill's wastewater is applied toward irrigation of adjacent farmland, reducing their dependency upon direct release, Cargill is the only existing[**] meat processing facility in Alberta that has been approved to release wastewater to a receiving watercourse.

There are also numerous small-scale meat processors in Alberta. Though they do not currently require approval for effluent discharge to a receiving stream, a number of them may soon be covered by a proposed Code of Practice. There are a few meat processing operations located in urban areas which release their liquid wastes directly into municipal wastewater treatment systems. Of these, the larger facilities require individual, direct operating approval from AEP, while the smaller ones will also be covered by the proposed Code of Practice.

Alberta's only approved, directly discharging meat processor is described in the following table:

Meat Processing Plants General Information

plant	receiving stream	basin	location	opened
Cargill	Frank Lake	Little Bow River	High River	pre-1990

Monitoring

Seven separate discharge monitoring requirements have been defined for this sector, of which five are included in this report: ammonia-N, BOD, TSS, oil & grease, and flow. The imposed effluent discharge limits for each of these plants is summarized in the following table.

---

[*] Cargill is licensed to slaughter 1.05 million head per year, while Lakeside can slaughter 1.575 million.

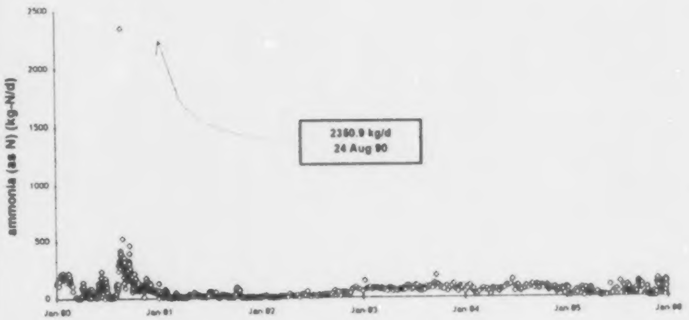
[**] A fish processing plant operated by Rocky Mountain Seafood Ltd. has been approved by AEP for discharge release into Cochrane Lake in the Hillspring area. Construction is scheduled to commence in 1996.

Meat Processing Plants Mandated Effluent Limits

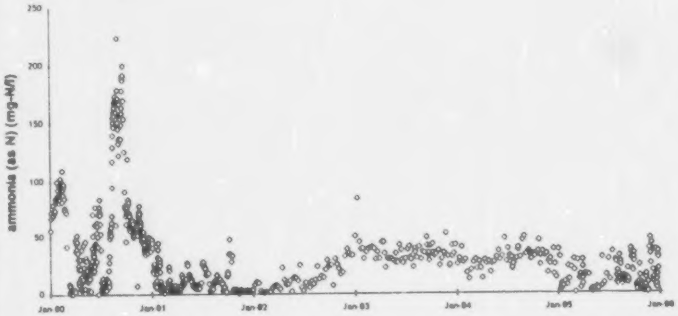
plant	parameter	1995 daily limit (mg/l)	1995 monthly limit (mg/l)
Cargill	ammonia-N	50	30
	BOD	30	15
	TSS	60	30
	oil & grease	not applicable	not applicable

Ammonia

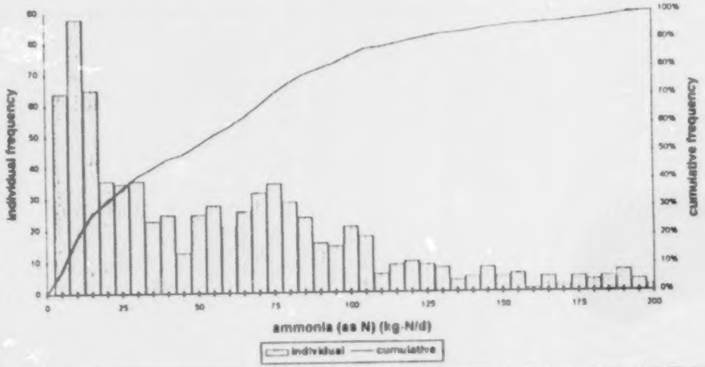
Performance Summary: Meat Processors
Individual Daily Ammonia Loading (mass-loading) - Time Series
Cargill Limited: 1990-1995



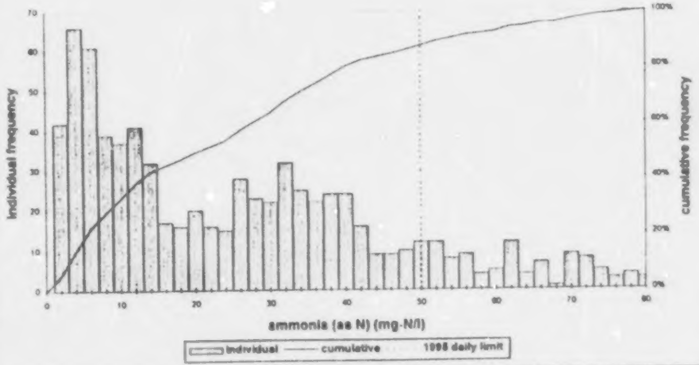
Performance Summary: Meat Processors
Individual Daily Ammonia Loading (concentration) - Time Series
Cargill Limited: 1990-1995



Performance Summary: Meat Processors
Individual Daily Ammonia Loading (mass-loading) - Frequency Distribution
Cargill Limited: 1990-1995



Performance Summary: Meat Processors
Individual Daily Ammonia Loading (concentration) - Frequency Distribution
Cargill Limited: 1990-1995

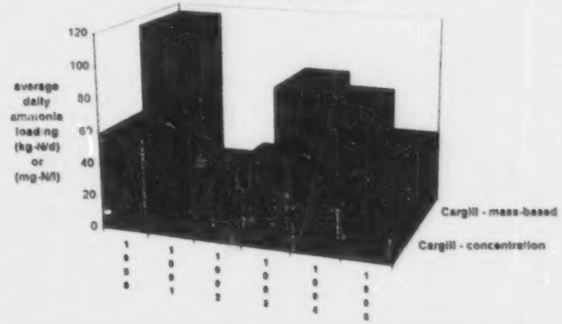


		Cargill (kg-N/d)	Cargill (mg-N/l)
mode of operation:		continuous	continuous
total samples 1990-1995:		823	826
average for:	1990	114.7	58.8
	1991	19.5	10.9
	1992	26.3	14.9
	1993	80.9	35.8
	1994	71.2	30.2
	1995	44.9	15.6
	1990-1995	69.6	34.0

Performance Summary: Meat Processors

Annually Averaged Daily Ammonia Loading

all plants ; 1990-1995



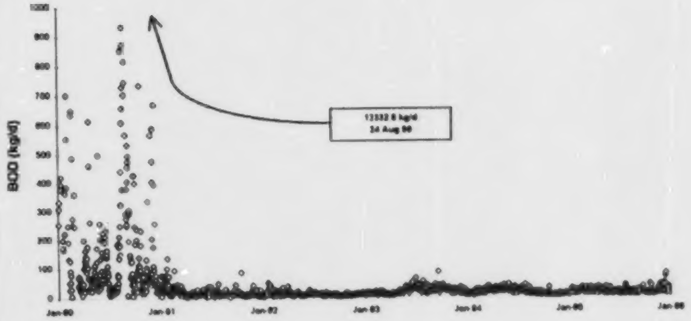
ammonia (as N): calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg-N/d):	
plant	x (kg-N/d)	s (kg-N/d)	x (kg-N/d)	s (kg-N/d)	x (kg-N/d)	s (kg-N/d)	x (kg-N/d)	s (kg-N/d)	x (kg-N/d)	s (kg-N/d)	x (kg-N/d)	s (kg-N/d)	daily	monthly
Cargill	114.7	166.2	19.5	19.7	26.3	22.3	80.9	23.4	71.2	23.1	44.9	38.0	-	-

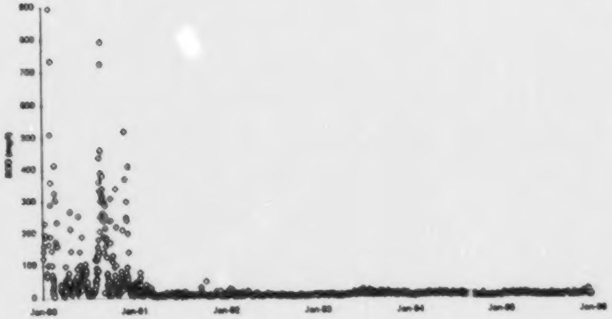
	1990		1991		1992		1993		1994		1995		1995 imposed limits (mg-N/l):	
plant	x (mg-N/l)	s (mg-N/l)	x (mg-N/l)	s (mg-N/l)	x (mg-N/l)	s (mg-N/l)	x (mg-N/l)	s (mg-N/l)	x (mg-N/l)	s (mg-N/l)	x (mg-N/l)	s (mg-N/l)	daily	monthly
Cargill	58.8	49.0	10.9	10.2	14.9	11.6	35.8	8.9	30.2	8.0	15.6	12.0	60	30

Biochemical Oxygen Demand
(BOD)

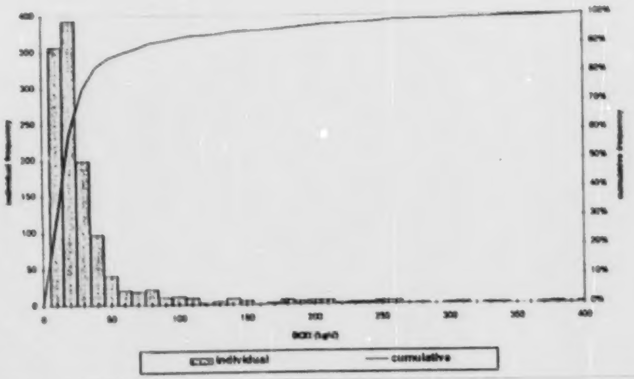
Performance Summary: Meat Processors
Individual Daily BOD Loading (mass-loading) - Time Series
Cargill Limited: 1990-1995



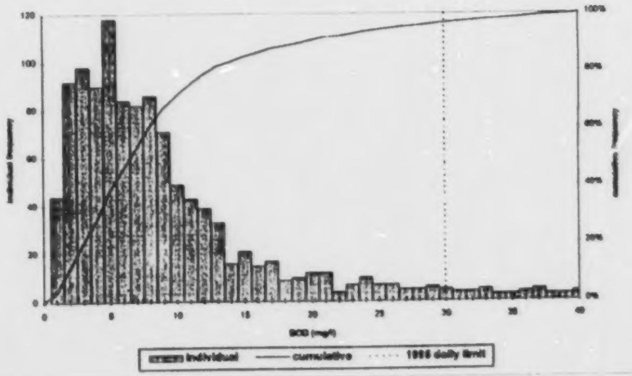
Performance Summary: Meat Processors
Individual Daily BOD Loading (concentration) - Time Series
Cargill Limited : 1990-1995



Performance Summary: Meat Processors
Individual Daily BOD Loading (mass-loading)- Frequency Distribution
Cargill Limited: 1990-1995



Performance Summary: Meat Processors
Individual Daily BOD Loading (concentration) - Frequency Distribution
Cargill Limited: 1990-1995

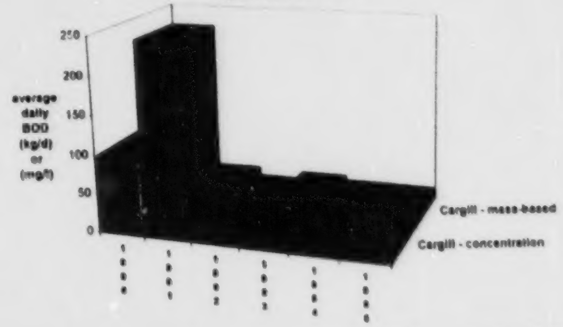


	Cargill (kg/d)	(mg/l)
mode of operation:	continuous	continuous
total samples 1990-1995:	1314	1318
average for: 1990	221.6	98.2
1991	21.4	12.4
1992	10.4	6.0
1993	20.2	6.7
1994	13.9	5.8
1995	13.8	6.0
1990-1995	66.1	29.8

Performance Summary: Meat Processors

Annually Averaged Daily BOD Loading

all plants ; 1990-1995

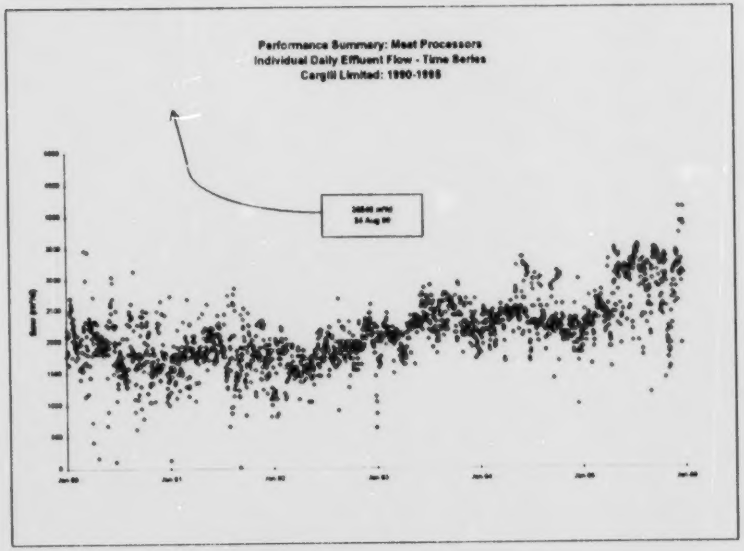


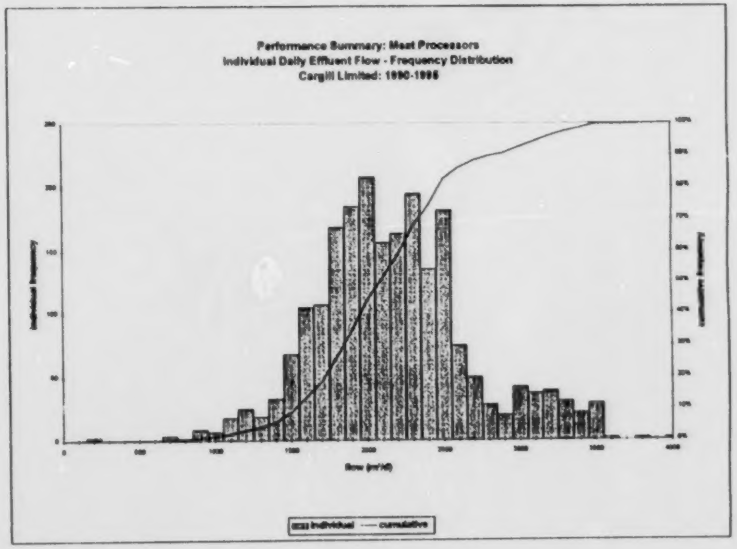
BOD: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

plant	1990 x (kg/d)	s (kg/d)	1991 x (kg/d)	s (kg/d)	1992 x (kg/d)	s (kg/d)	1993 x (kg/d)	s (kg/d)	1994 x (kg/d)	s (kg/d)	1995 x (kg/d)	s (kg/d)	1995 imposed limits (kg/d): daily	monthly
Cargill	221.6	726.3	21.4	18.3	10.4	7.9	20.2	10.8	13.9	6.7	13.8	9.3	-	-

plant	1990 x (mg/l)	s (mg/l)	1991 x (mg/l)	s (mg/l)	1992 x (mg/l)	s (mg/l)	1993 x (mg/l)	s (mg/l)	1994 x (mg/l)	s (mg/l)	1995 x (mg/l)	s (mg/l)	1995 imposed limits (mg/l): daily	monthly
Cargill	98.2	129.9	12.4	11.0	6.0	4.4	6.7	3.8	5.8	3.4	6.0	3.1	30	15

Effluent Flow


Performance Summary: Meat Processors
Individual Daily Effluent Flow - Time Series
Cargill Limited: 1990-1995


Performance Summary: Meat Processors
Individual Daily Effluent Flow - Frequency Distribution
Cargill Limited: 1990-1995

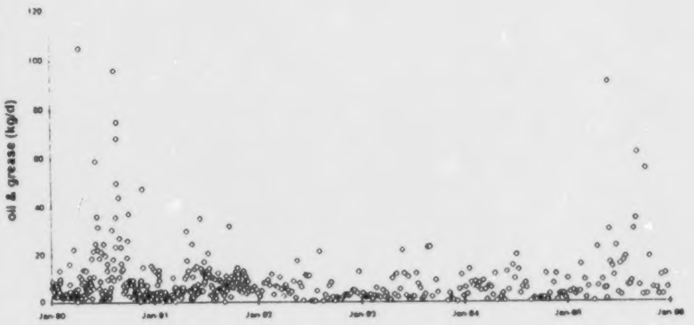
	Cargill (m³/d)
mode of operation:	continuous
total samples 1990-1995:	2183
average for: 1990	1963.8
1991	1788.3
1992	1789.3
1993	2240.8
1994	2322.7
1995	2771.7
1990-1995	2143.8

effluent flow: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

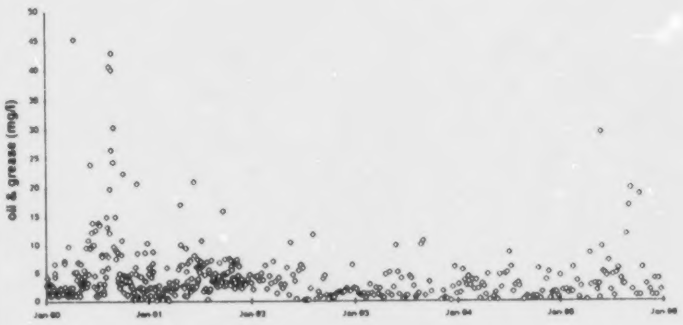
	1990		1991		1992		1993		1994		1995		1996 imposed limits (kg/d):	
plant	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	daily	monthly
Cargill	1963.8	1968.0	1788.3	370.4	1789.3	289.8	2240.8	338.8	2322.7	324.3	2771.7	631.8	-	-

Oil & Grease

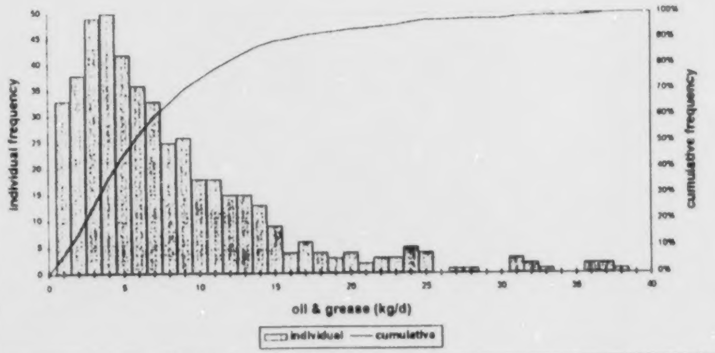
Performance Summary: Meat Processors
Individual Daily Oil & Grease Loading (mass-loading) - Time Series
Cargill Limited: 1990-1995



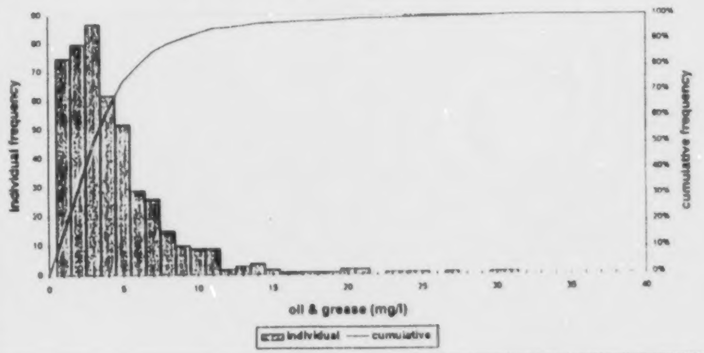
Performance Summary: Meat Processors
Individual Daily Oil & Grease Loading (concentration) - Time Series
Cargill Limited : 1990-1995



Performance Summary: Meat Processors
Individual Daily Oil & Grease Loading (mass-loading)- Frequency Distribution
Cargill Limited: 1990-1995



Performance Summary: Meat Processors
Individual Daily Oil & Grease Loading (concentration) - Frequency Distribution
Cargill Limited: 1990-1995

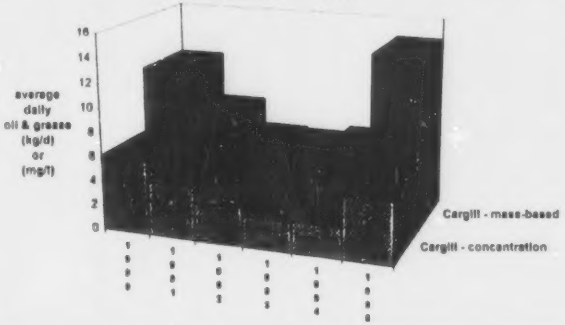


	Cargill (kg/d)	Cargill (mg/l)
mode of operation:	continuous	continuous
total samples 1990-1995:	482	483
average for: 1990	11.6	6.2
1991	7.8	4.3
1992	5.6	3.2
1993	5.4	2.5
1994	6.0	2.6
1995	14.2	5.0
1990-1995	9.0	4.5

Performance Summary: Meat Processors

Annually Averaged Daily Oil & Grease Loading

all plants ; 1990-1995



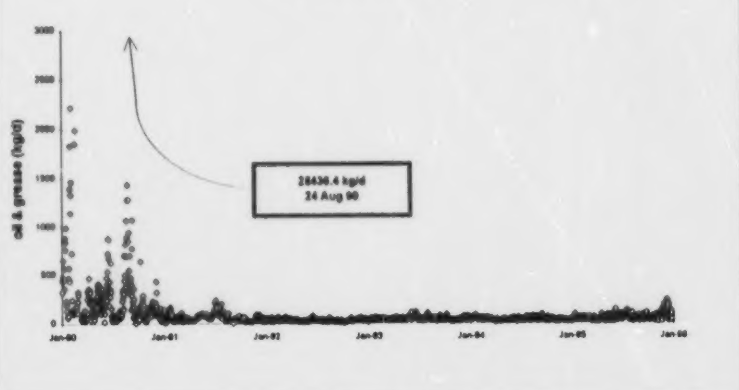
oil & grease: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Cargill	11.6	16.1	7.8	5.8	5.6	4.5	5.4	5.8	6.0	4.7	14.2	17.5	-	-

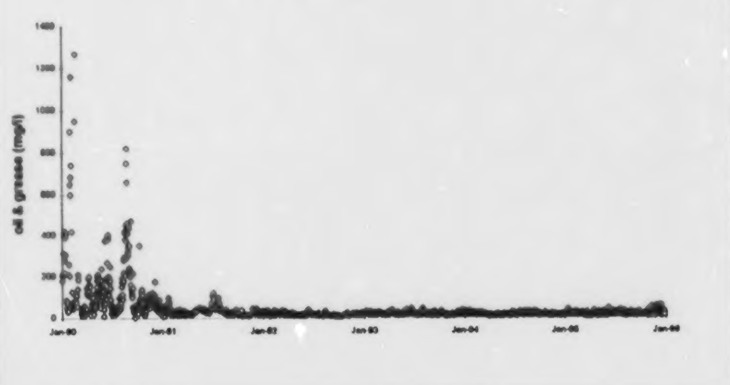
	1990		1991		1992		1993		1994		1995		1995 imposed limits (mg/l):	
plant	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	daily	monthly
Cargill	6.2	8.0	4.3	3.0	3.2	2.5	2.5	2.6	2.6	2.0	5.0	5.9	-	-

Total Suspended Solids
(TSS)

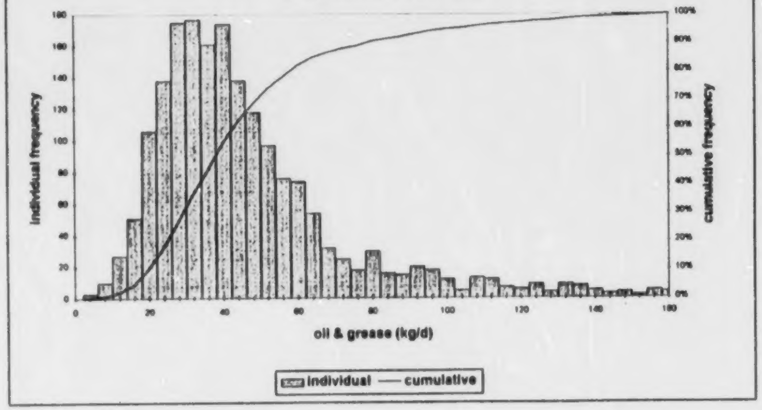
Performance Summary: Meat Processors
Individual Daily TSS Loading (mass-loading) - Time Series
Cargill Limited: 1990-1995



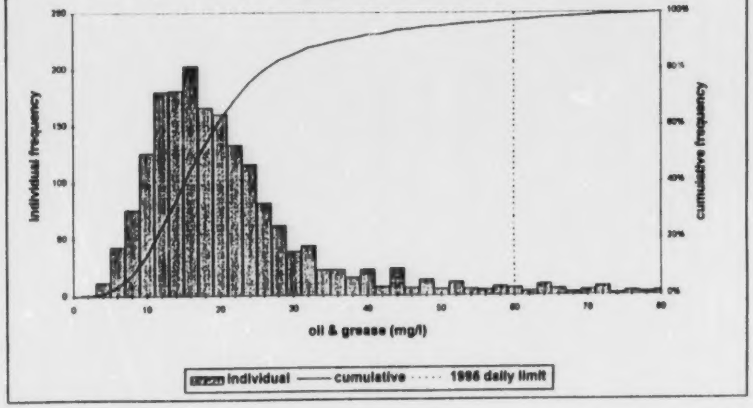
Performance Summary: Meat Processors
Individual Daily TSS Loading (concentration) - Time Series
Cargill Limited : 1990-1995



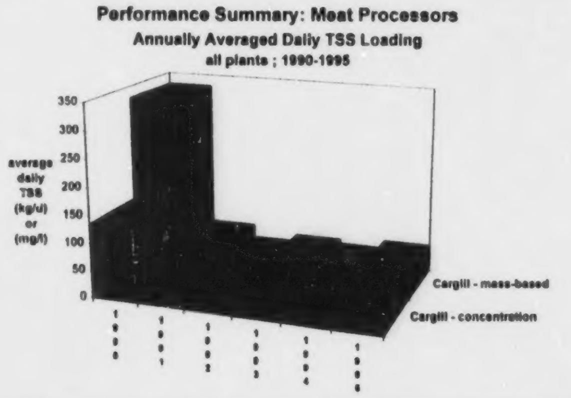
Performance Summary: Meat Processors
Individual Daily TSS Loading (mass-loading) - Frequency Distribution
Cargill Limited: 1990-1995



Performance Summary: Meat Processors
Individual Daily TSS Loading (concentration) - Frequency Distribution
Cargill Limited: 1990-1995



		Cargill	
		(kg/d)	(mg/l)
mode of operation:		continuous	continuous
total samples 1990-1995:		2022	2026
average for:	1990	328.1	134.8
	1991	63.7	30.0
	1992	29.4	16.6
	1993	42.5	19.2
	1994	34.7	15.0
	1995	49.2	17.5
	1990-1995	89.2	38.4

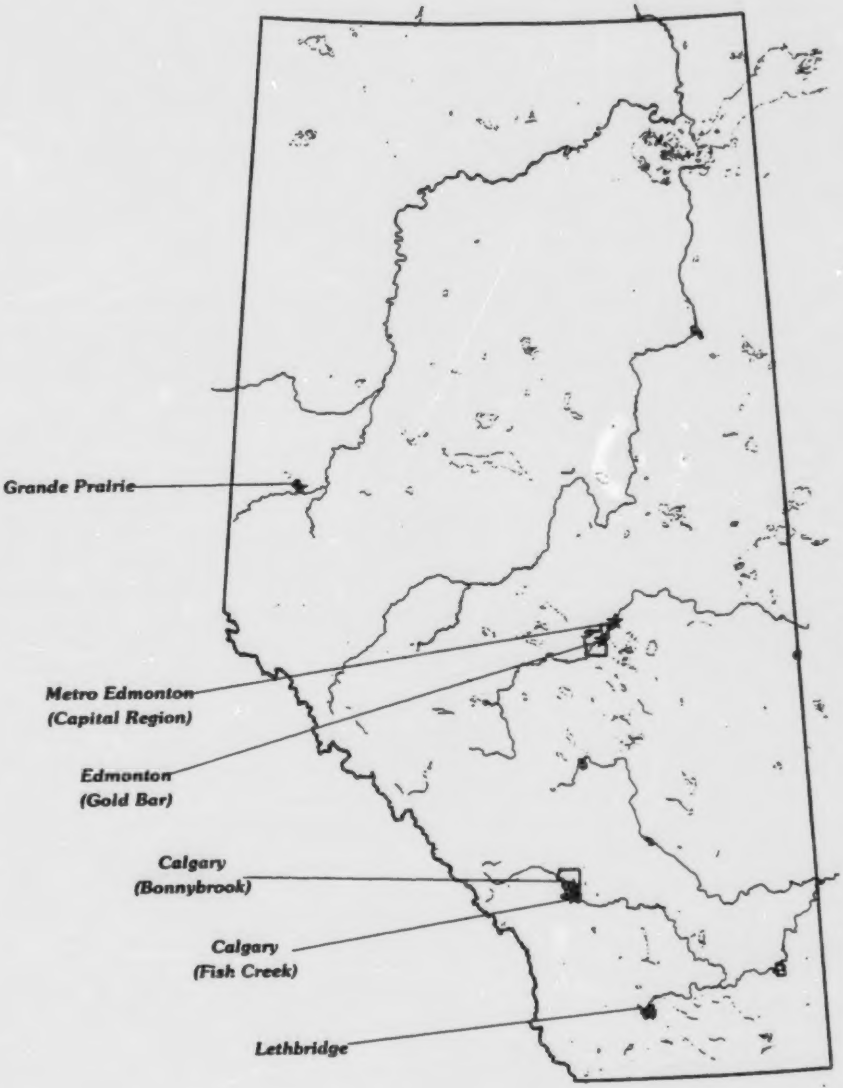


TSS: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Cargill	328.1	1403.1	63.7	34.7	29.4	12.1	42.5	15.4	34.7	13.7	49.2	30.6	-	-

	1990		1991		1992		1993		1994		1995		1995 imposed limits (mg/l):	
plant	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	daily	monthly
Cargill	134.8	167.0	30.0	17.1	16.6	6.6	19.2	6.7	15.0	5.8	17.5	9.4	60	30

Municipal Wastewater Treatment Plants


Grande Prairie
Metro Edmonton (Capital Region)
Edmonton (Gold Bar)
Calgary (Bonnybrook)
Calgary (Fish Creek)
Lethbridge

Municipal Wastewater Treatment Plants

General

With respect to the general practice of wastewater treatment in Alberta, the term municipal wastewater treatment plant (WWTP) is very broad. Depending upon local population, the WWTP's location and the specific demands of local industries, municipalities may process their wastewater by a variety of treatment systems ranging from wastewater lagoons to full-scale mechanical plants before releasing it to a receiving stream. This stream may be a river, a lake, or an irrigation canal. A number of municipal WWTP's in Alberta have been approved by AEP for direct discharge into rivers in every basin in the province.

In this report, four major municipalities are examined, for a total of six treatment facilities. Calgary has two plants, Bonnybrook and Fish Creek, both located on the Bow River. Bonnybrook currently practices prechlorination, primary and secondary clarification, aeration , phosphorous control, ammonia-N control and disinfection. Fish Creek practices primary and secondary clarification, aeration, phosphorous control and disinfection. Calgary's two plants have a combined design capacity of 523 Ml/d. Edmonton's Gold Bar plant is located within the City of Edmonton on the North Saskatchewan River. Gold Bar currently practices primary and secondary clarification, and activated sludge treatment, while facilities for tertiary treatment (biological nutrient removal and UV disinfection) are now under construction. Gold Bar has a design capacity of 316 Ml/d. The Capital Region Sewage Commission's plant is also situated on the North Saskatchewan River, between Edmonton and Fort Saskatchewan. The Capital Region plant serves the communities and industries surrounding Edmonton as well as parts of Edmonton itself. Primary and secondary clarification and activated sludge treatment are employed, and the plant has a design capacity of roughly 90 Ml/d. Grande Prairie's wastewater treatment plant has a design capacity of 28.4 Ml/d and employs aeration, primary and secondary clarification, and rotating biological contactors before the effluent is discharged to the Wapiti River. Finally, the City of Lethbridge practices primary and secondary clarification, activated sludge treatment with nutrient control, and UV disinfection; the plant has a design capacity of 49 Ml/d and is located on the Oldman River within the City of Lethbridge.

These facilities are summarised in the following table:

Municipal Wastewater Treatment Plants General Information

plant	receiving stream	location	opened
Bonnybrook	Bow River	Calgary	pre-1990
Fish Creek	Bow River	Calgary	pre-1990
Gold Bar	North Saskatchewan River	Edmonton	pre-1990
Capital Region	North Saskatchewan River	Metro Edmonton	pre-1990

plant	receiving stream	location	opened
Grande Prairie	Wapiti River	Grande Prairie	pre-1990
Lethbridge	Oldman River	Lethbridge	pre-1990

Monitoring

In general, two parameters (BOD and TSS) are regulated for those plants employing secondary treatment, while four parameters (BOD, TSS, total phosphorous and coliforms) are regulated for those plants employing tertiary treatment. Ammonia is regulated if an impact upon the receiving stream is anticipated. In addition, the municipalities may opt to monitor a number of additional parameters: for instance, Calgary's Bonnybrook plant monitors an extensive set of metals, ions and nutrients in addition to general indicators such as COD & TOC, though only BOD, coliforms, total phosphorous and TSS are the regulated parameters for that facility. Despite the abundance of such monitoring data for the larger cities, monitoring data for the smaller cities are generally less abundant. Consequently, only five parameters are examined in this report, BOD, TSS, total phosphorous, ammonia-N and effluent flow.

Because each municipal WWTP considered in this report is a mechanical plant, has secondary or tertiary treatment, and serves a large design population, each plant (with the exception of Edmonton's Gold Bar plant) is subject to the same set of imposed effluent discharge limits. At the present time, Gold Bar is subject to slightly different limits for BOD & TSS, though these will be revised once Gold Bar is upgraded. The limits are summarised in the following table:

Municipal Wastewater Treatment Plants
Mandated Effluent Limits

plant	parameter	1995 imposed standard (mg/l)	comments
all* except Gold Bar	ammonia-N	none	-
	BOD	20 mg/l	monthly average of daily samples
	TSS	20 mg/l	monthly average of daily samples
Gold Bar	ammonia-N	none	-
	BOD	25 mg/l	monthly average of daily samples
	TSS	25 mg/l	monthly average of daily samples

---

[*] Grande Prairie is a batch operation; all others are continuously discharging.

In addition, Bonnybrook (Calgary) is one of only two municipal WWTP's for which limits upon total phosphorous are currently imposed*. This limit is set at 1 mg/l for the monthly average of twice-weekly samples.

These limits are all concentration-based (mg/l) - typical practice for the regulation of municipal WWTP's in Alberta. However, because such limits are inconsistent with both the mass-based limits (kg/d) currently specified for most of the other industrial sectors, and also with and mass-based effluent monitoring data presented throughout this report, all effluent monitoring data for this sector are presented *both* in kg/d and in mg/l. Only the release of treated effluent is considered: the release of untreated sewage directly to the receiving stream (*e.g.* during very high-flow events) is not addressed.

Unfortunately, local variation in the practice of data collection and storage has prevented some of Alberta's largest urban centres from being considered in this report since monitoring data simply could not be readily obtained. It is hoped that these centres can be incorporated into future revisions of this report.

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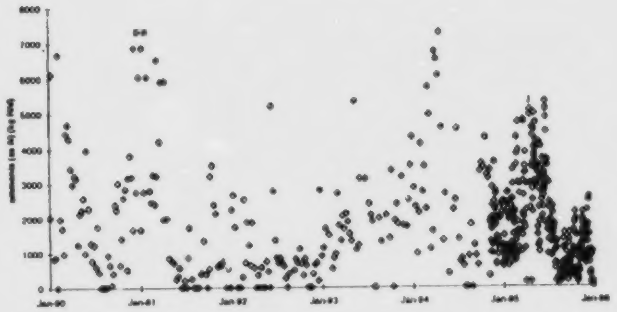
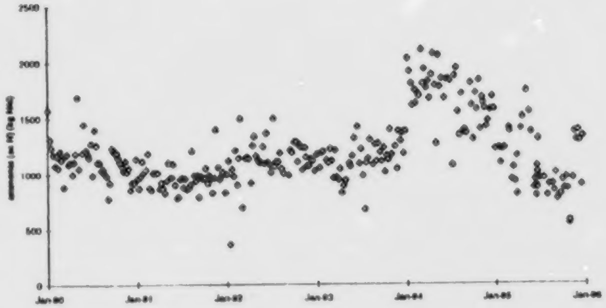
* Medicine Hat is also limited for total phosphorous, but it is not presented in this report.

Ammonia

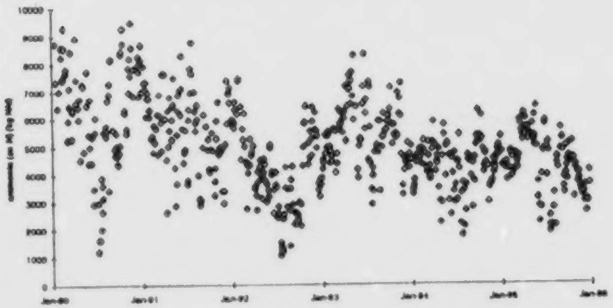
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series
Bonnybrook (Calgary): 1990-1995



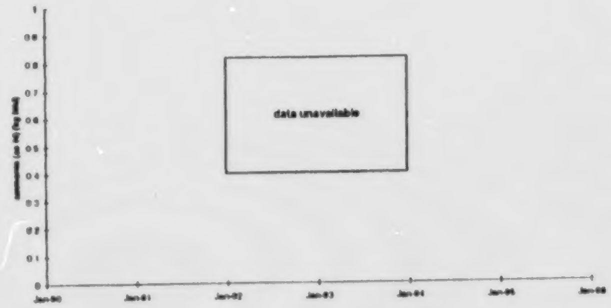
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series
Fish Creek (Calgary): 1990-1995



Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series
Gold Bar (Edmonton): 1990-1995

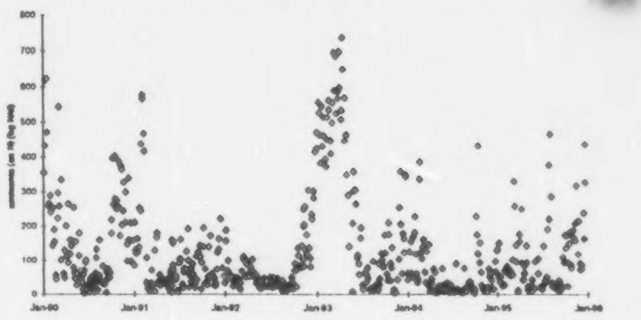


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series
Capital Region (Metro Edmonton): 1990-1995

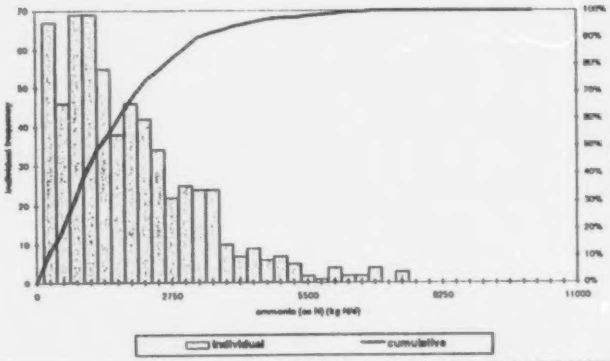


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series
Grande Prairie: 1990-1995

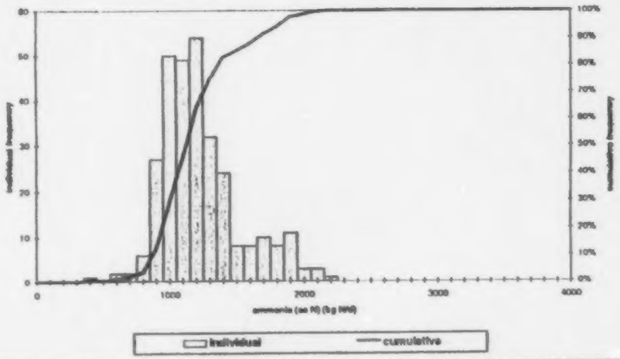
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series
Lethbridge: 1990-1995



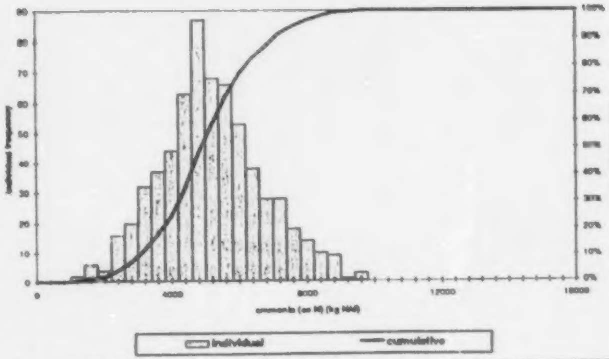
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution
Bonnybrook (Calgary): 1990-1995



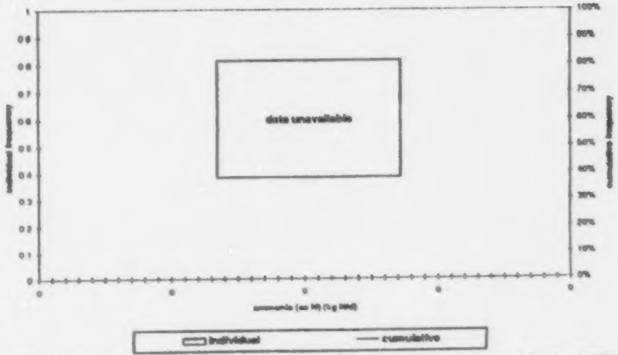
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution
Fish Creek (Calgary): 1990-1995



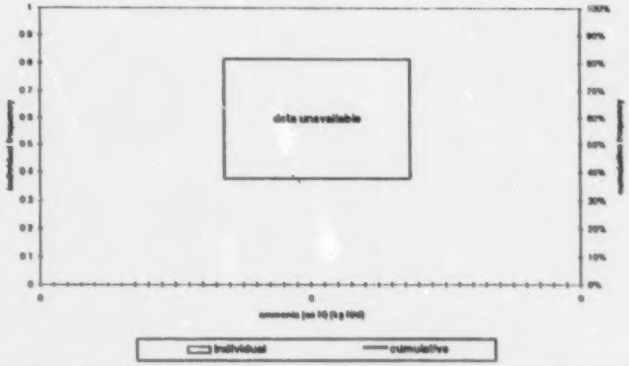
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution
Gold Bar (Edmonton): 1990-1995



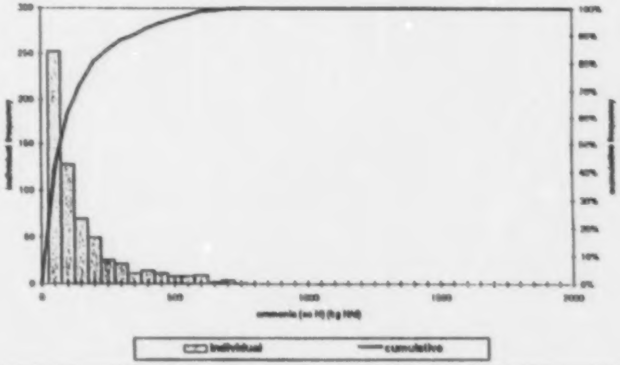
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution
Capital Region (Metro Edmonton): 1990-1995



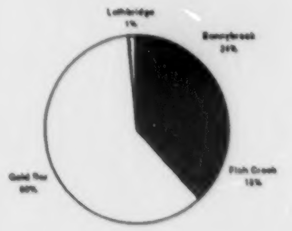
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution
Grande Prairie: 1990-1995



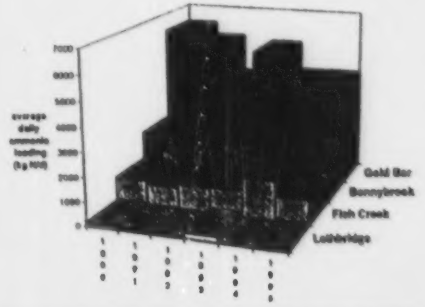
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution
Lethbridge: 1990-1995



Performance Summary: Municipal Wastewater Treatment Plants
Average Daily Ammonia Loading for 1995
non-batch plants only
100% = 7164.9 kg N/d aggregate NH3-N loading



Performance Summary: Municipal Wastewater Treatment Plants
Annually Averaged Daily Ammonia Loading
non-batch plants only ; 1990-1995



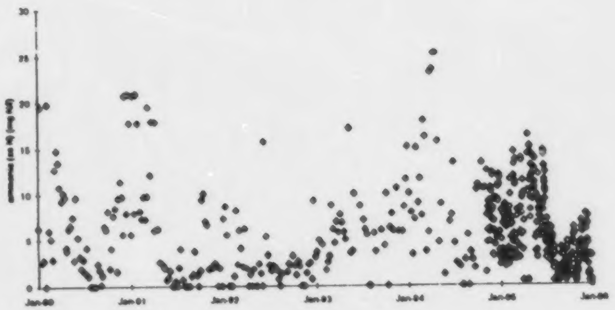
calculation of aggregate (non batch plants only) (kg N/d):

		Bonnybrook	Fish Creek	Gold Bar	Capital Region	Grande Prairie	Lethbridge	*aggregate (kg N/d):* all
total samples 1990-1995:		623	299	647	0	0	623	2192
average for:	1990	2273.38	1130.81	6216.79	-		155.72	9776.71
	1991	1768.16	963.17	5649.33	-		97.27	8497.94
	1992	860.35	1117.79	4048.45	-		75.82	6102.41
	1993	1927.15	1141.23	5475.76	-		261.71	8805.85
	1994	2215.83	1688.77	4285.27	-		62.47	8252.34
	1995	1693.16	1059.69	4305.06	-		107.03	7164.93
	1990-1995	1770.91	1180.66	4965.70	-		126.21	8043.49

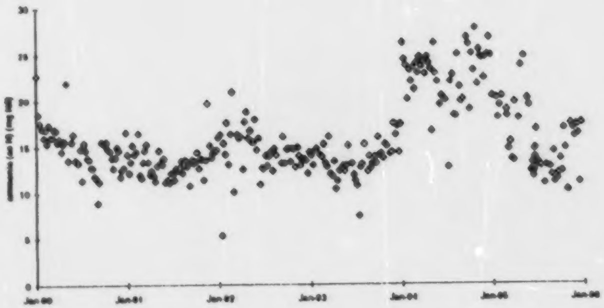
NH3-N: ***calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995***

mill	1990 x (kg N/d)	s (kg N/d)	1991 x (kg N/d)	s (kg N/d)	1992 x (kg N/d)	s (kg N/d)	1993 x (kg N/d)	s (kg N/d)	1994 x (kg N/d)	s (kg N/d)	1995 x (kg N/d)	s (kg N/d)	1995 imposed limits (kg N/d): daily	monthly
Bonnybrook	2273.38	1877.13	1768.16	2068.97	860.35	991.58	1927.15	1092.01	2215.83	1523.97	1693.16	1227.22	n/a	n/a
Fish Creek	1130.81	164.38	963.17	110.73	1117.79	175.92	1141.23	152.78	1688.77	225.18	1059.69	259.64	n/a	n/a
Gold Bar	6216.79	1876.42	5649.33	1362.00	4048.45	1499.80	5475.76	1114.45	4285.27	850.96	4305.06	1045.99	n/a	n/a
Capital Region	-	-	-	-	-	-	-	-	-	-	-	-	n/a	n/a
Grande Prairie	-	-	-	-	-	-	-	-	-	-	-	-	n/a	n/a
Lethbridge	155.72	138.73	97.27	104.09	75.82	74.58	261.71	220.70	62.47	79.02	167.03	98.29	n/a	n/a

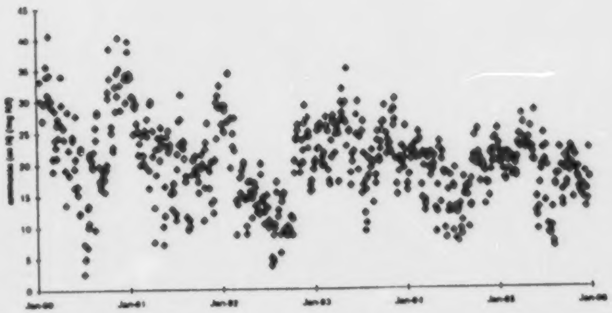
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series (in mg/l)
Bonnybrook (Calgary): 1990-1995



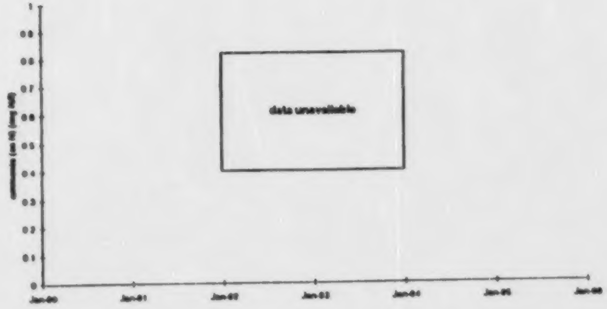
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series (in mg/l)
Fish Creek (Calgary): 1990-1995



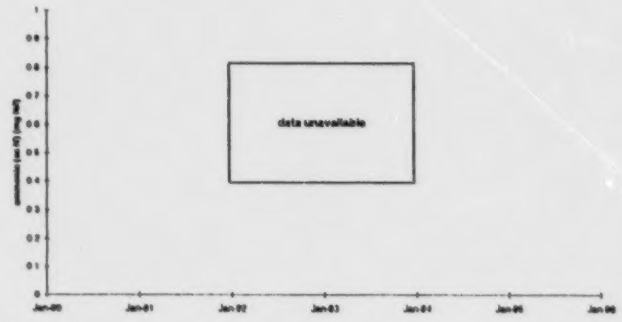
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series (in mg/l)
Gold Bar (Edmonton): 1990-1995



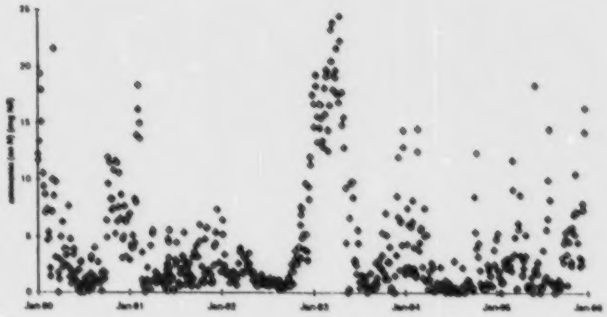
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series (in mg/l)
Capital Region (Metro Edmonton): 1990-1995



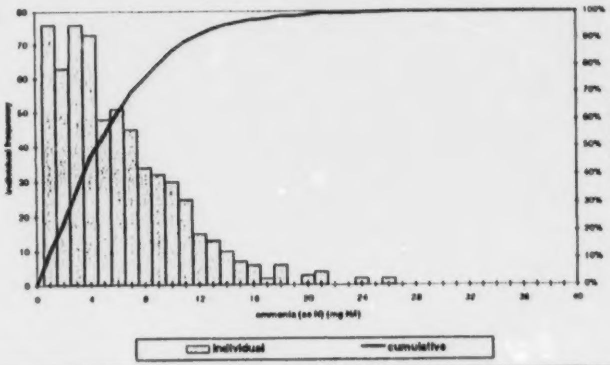
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series (in mg/l)
Grande Prairie: 1990-1995



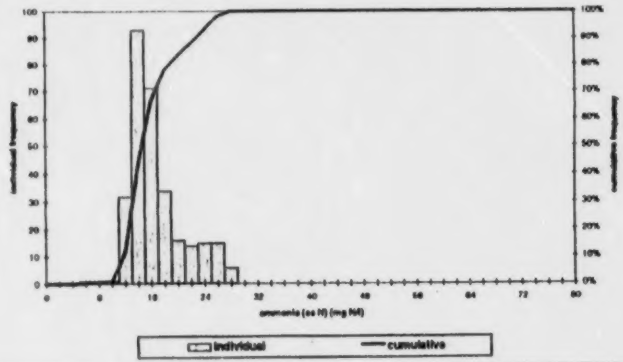
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Time Series (in mg/l)
Lethbridge: 1990-1995



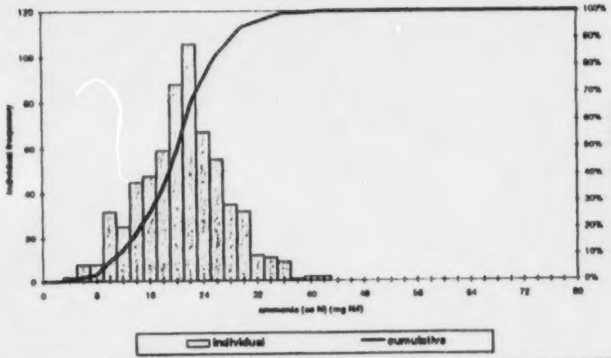
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution (in mg/l)
Bonnybrook (Calgary): 1990-1995



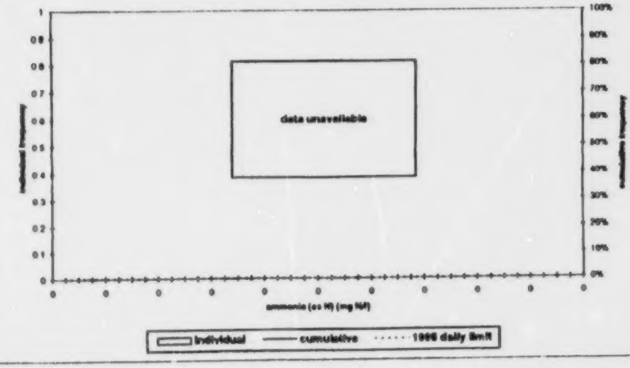
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution (in mg/l)
Fish Creek (Calgary): 1990-1995



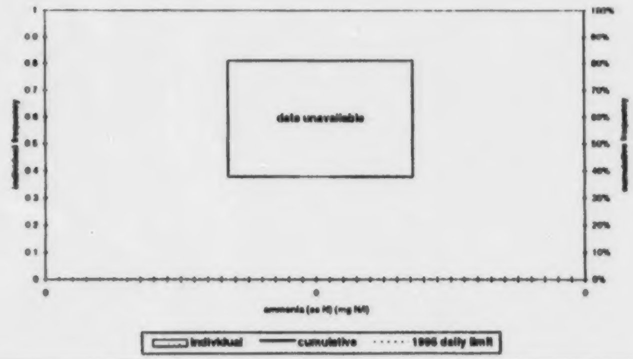
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution (in mg/l)
Gold Bar (Edmonton): 1990-1995



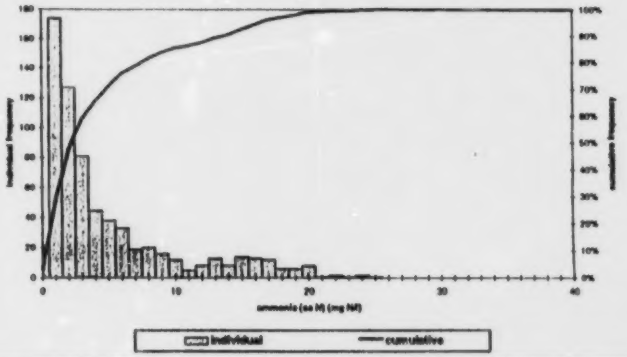
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution (in mg/l)
Capital Region (Metro Edmonton): 1990-1995



Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution (in mg/l)
Grande Prairie: 1990-1995



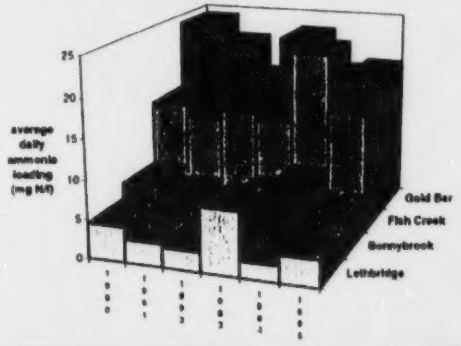
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Ammonia Loading - Frequency Distribution (in mg/l)
Lethbridge: 1990-1995



Performance Summary: Wastewater Treatment Plants

Annually Averaged Daily Ammonia Loading

all plants (only 4 reporting) ; 1990-1995



		average daily NH3-N loading (mg N/l):					
		Bonnybrook	Fish Creek	Gold Bar	Capital Region	Grande Prairie	Lethbridge
total samples 1990-1995:		623	299	647	0	0	686
average for:	1990	6.66	14.88	23.88	-	-	4.54
	1991	5.27	13.28	21.04	-	-	3.03
	1992	2.60	14.49	16.42	-	-	2.57
	1993	6.18	13.65	22.57	-	-	8.21
	1994	8.21	22.79	17.69	-	-	2.13
	1995	5.12	15.39	18.47	-	-	3.50
	1990-1995	5.56	15.72	19.92	-	-	4.46

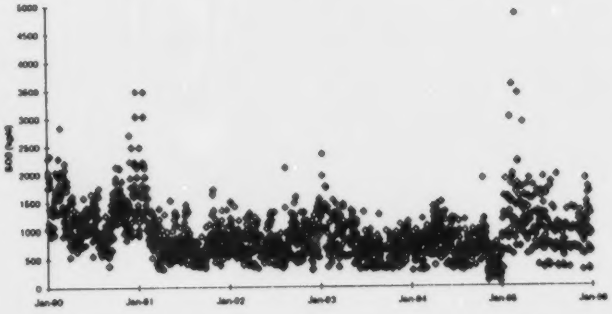
note:

Grande Prairie is a batch operation

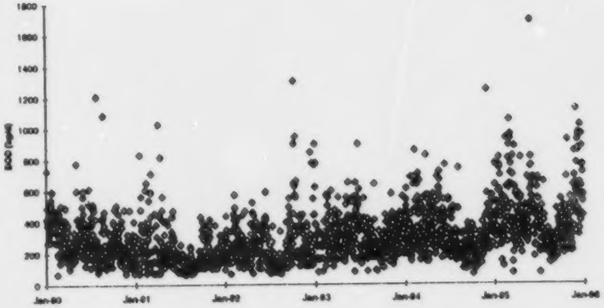
NH3-N: calculated annual average (x) and sample standard deviation (s) for each facility : 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (mg N/l):	
mill	x (mg N/l)	s (mg N/l)	x (mg N/l)	s (mg N/l)	x (mg N/l)	s (mg N/l)	x (mg N/l)	s (mg N/l)	x (mg N/l)	s (mg N/l)	x (mg N/l)	s (mg N/l)	daily	monthly
Bonnybrook	6.7	5.7	5.3	6.1	2.6	3.0	6.2	3.6	8.2	8.2	5.1	3.7	-	-
Fish Creek	14.9	2.4	13.3	1.6	14.5	2.4	13.6	1.9	22.8	2.9	15.4	3.5	-	-
Gold Bar	23.9	6.5	21.0	6.2	16.4	6.9	22.6	4.5	17.7	4.4	18.5	4.5	-	-
Capital Region	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grande Prairie	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lethbridge	4.5	4.5	3.0	3.3	2.6	2.8	8.2	7.9	2.1	2.8	3.5	3.6	-	-

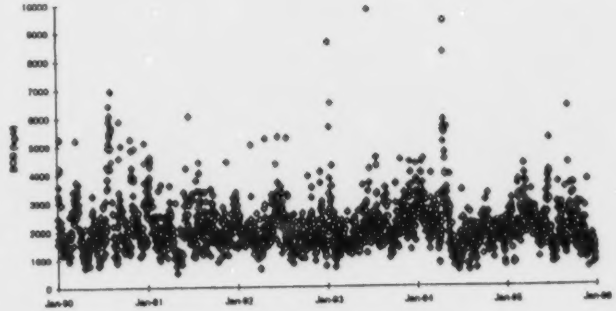
Biochemical Oxygen Demand
(BOD)



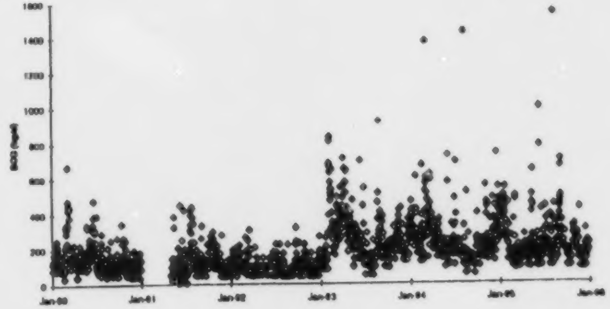
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series
Bonnybrook (Calgary): 1990-1995



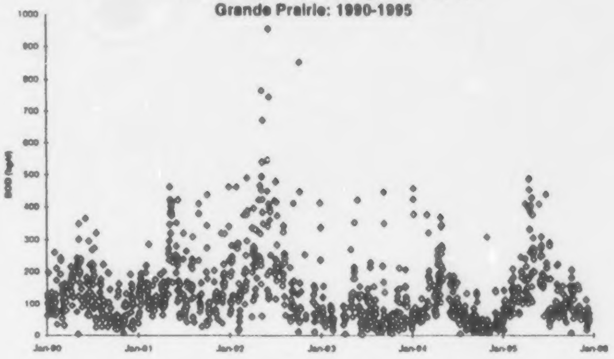
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series
Fish Creek (Calgary): 1990-1995

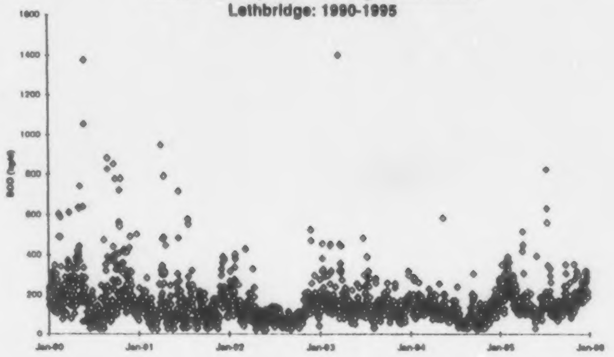


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series
Gold Bar (Edmonton): 1990-1995

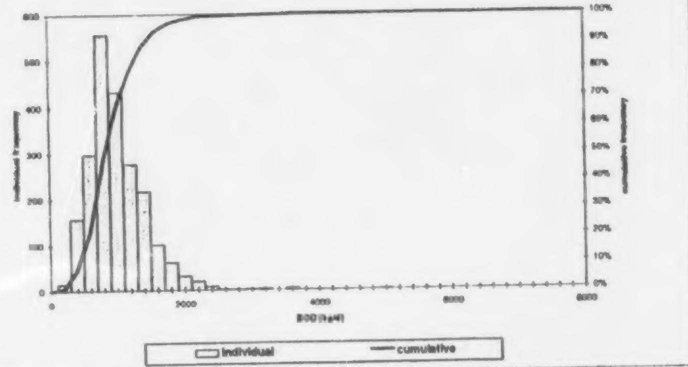


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series
Capital Region (Metro Edmonton): 1990-1995

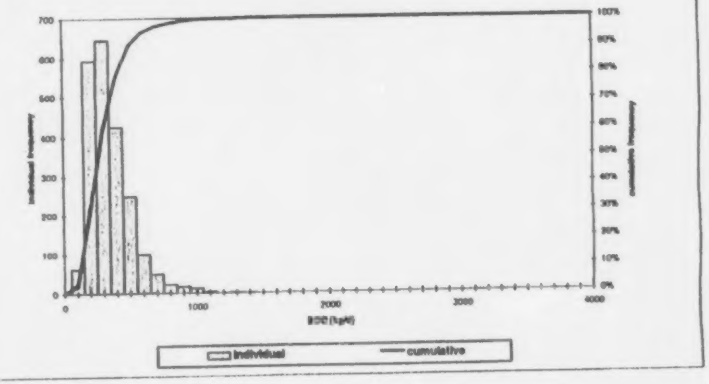

Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series
Grande Prairie: 1990-1995


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series
Lethbridge: 1990-1995

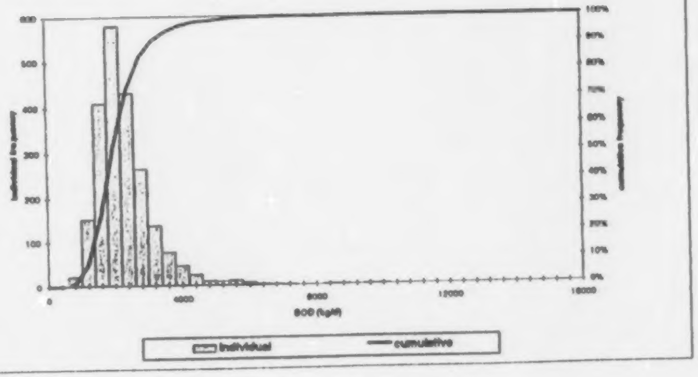
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution
Bonnybrook (Calgary): 1990-1995



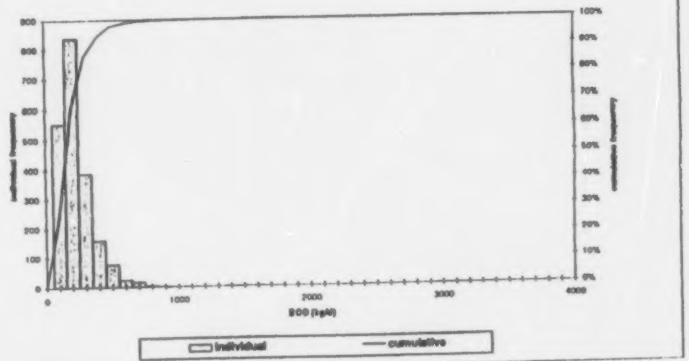
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution
Fish Creek (Calgary): 1990-1995



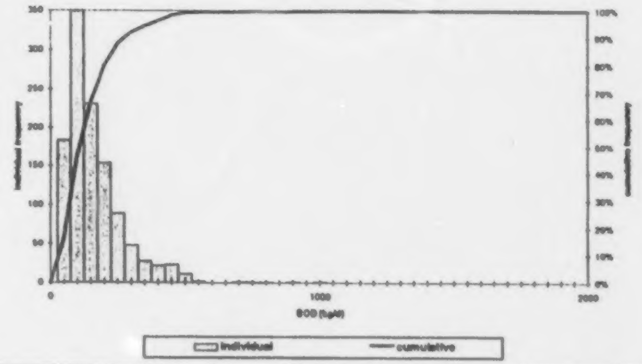
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution
Gold Bar (Edmonton): 1990-1995



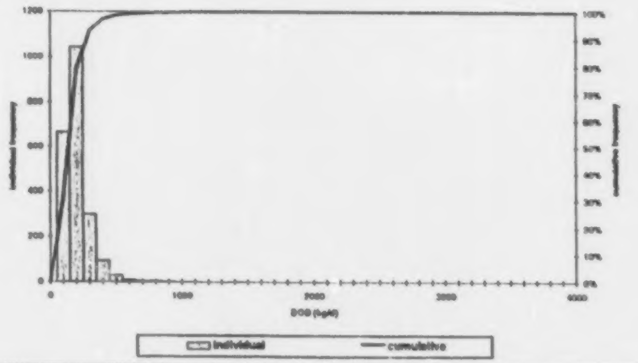
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution
Capital Region (Metro Edmonton): 1990-1995



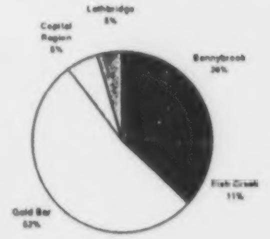
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution
Grande Prairie: 1990-1995



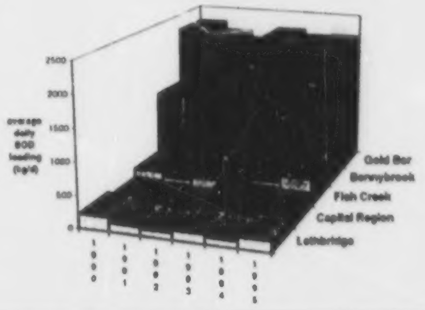
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution
Lethbridge: 1990-1995



Performance Summary: Municipal Wastewater Treatment Plants
Average Daily BOD Loading for 1995
non-batch plants only
100% = 3997.5 kg/d aggregate BOD loading



Performance Summary: Municipal Wastewater Treatment Plants
Annually Averaged Daily BOD Loading
non-batch plants only ; 1990-1995

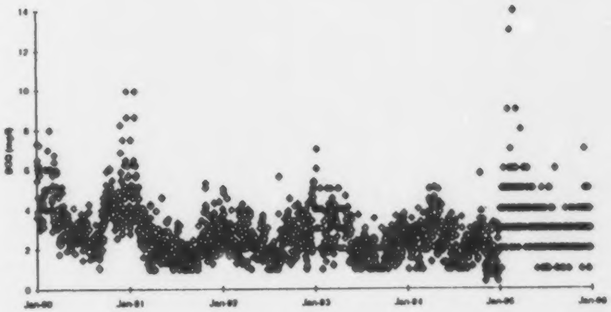


		calculation of aggregate (non-batch plants only) (kg/d):						aggregate (kg/d):
		Bonnybrook	Fish Creek	Gold Bar	Capital Region	Grande Prairie	Lethbridge	all
total samples 1990-1995:		2169	2190	2191	2062	1147	2168	11947
average for:	1990	1288.77	283.70	2236.24	145.82		222.69	4177.23
	1991	849.52	202.54	2103.30	128.45		143.28	3427.08
	1992	810.38	250.06	1979.02	99.51		111.86	3250.82
	1993	771.32	293.48	2177.72	253.88		155.85	3652.25
	1994	684.39	322.85	2093.08	249.49		116.33	3466.14
	1995	1044.42	433.51	2113.42	224.57		181.54	3997.45
	1990-1995	908.18	297.61	2117.07	186.66		155.28	3664.79

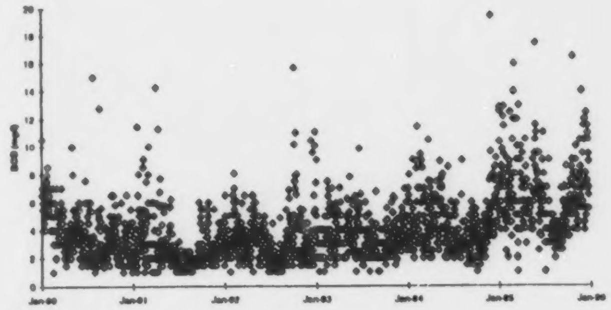
BOD: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
mill	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Bonnybrook	1288.77	434.56	849.52	401.14	810.38	274.70	771.32	308.67	684.39	284.22	1044.42	500.40	n/a	n/a
Fish Creek	283.70	130.74	202.54	124.09	250.06	151.14	293.48	117.89	322.85	149.61	433.51	204.11	n/a	n/a
Gold Bar	2236.24	1099.78	2103.30	755.93	1979.02	947.23	2177.72	905.52	2093.08	984.37	2113.42	745.90	n/a	n/a
Capital Region	145.82	80.51	128.45	81.77	99.51	61.12	253.88	141.55	249.49	147.00	224.57	135.31	n/a	n/a
Grande Prairie	122.74	68.79	159.46	92.16	220.63	180.32	88.74	78.91	96.90	84.02	136.81	92.81	n/a	n/a
Lethbridge	222.69	180.67	143.28	108.53	111.86	68.44	155.85	99.54	116.33	57.85	181.54	88.03	n/a	n/a

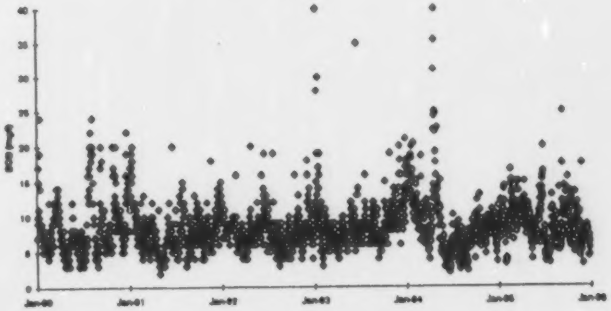
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series (in mg/l)
Bonnybrook (Calgary): 1990-1995



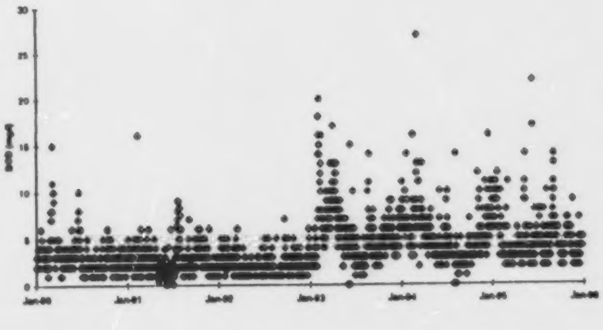
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series (in mg/l)
Fish Creek (Calgary): 1990-1995



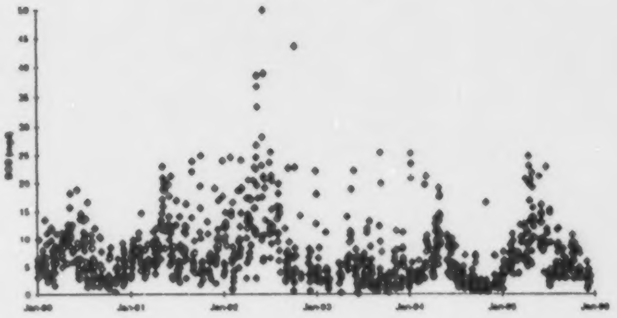
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series (in mg/l)
Gold Bar (Edmonton): 1990-1995



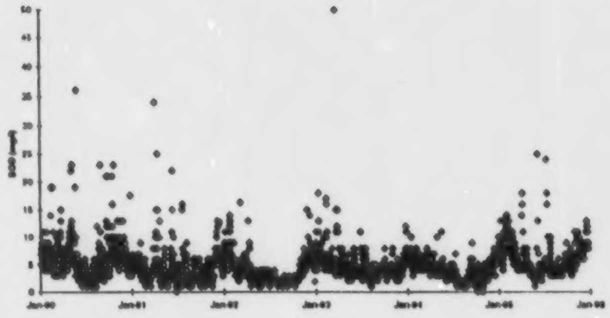
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series (in mg/l)
Capital Region (Metro Edmonton): 1990-1995



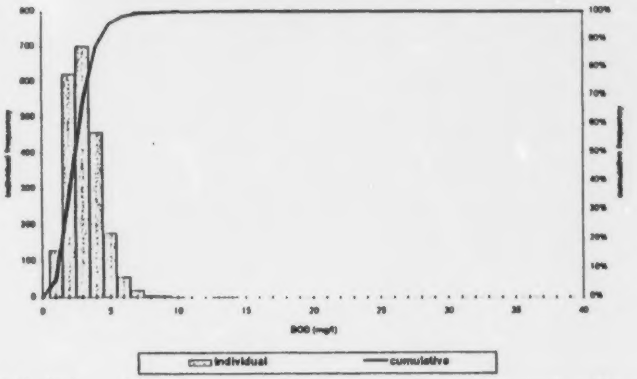
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series (in mg/l)
Grande Prairie: 1990-1995



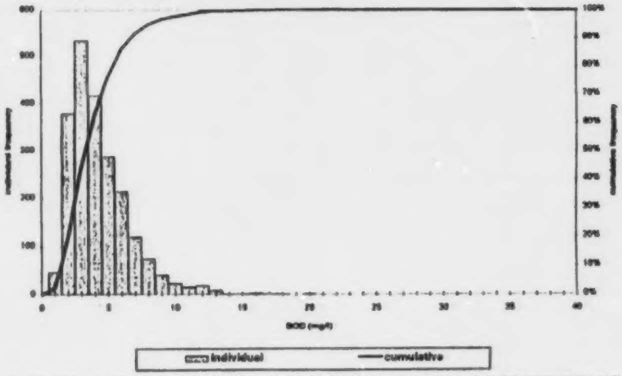
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Time Series (in mg/l)
Lethbridge: 1990-1995



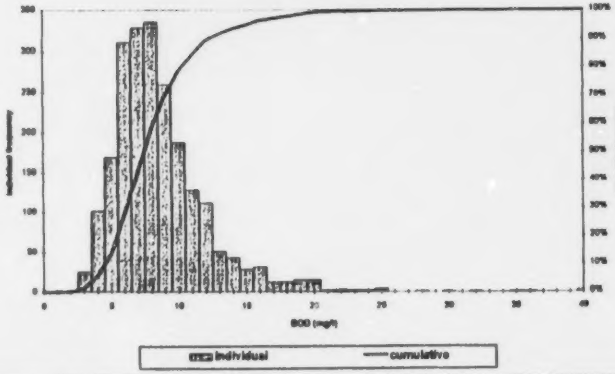
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution (in mg/l)
Bonnybrook (Calgary): 1990-1995



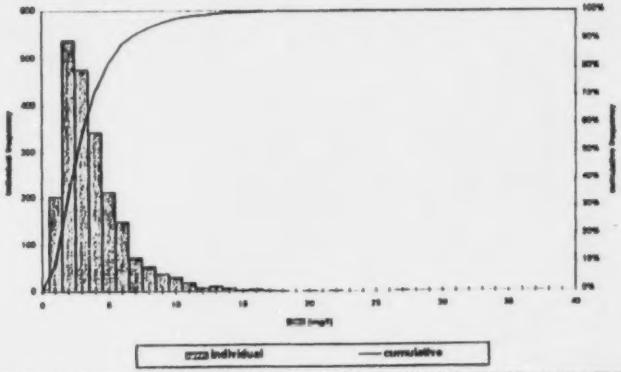
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution (in mg/l)
Fish Creek (Calgary): 1990-1995



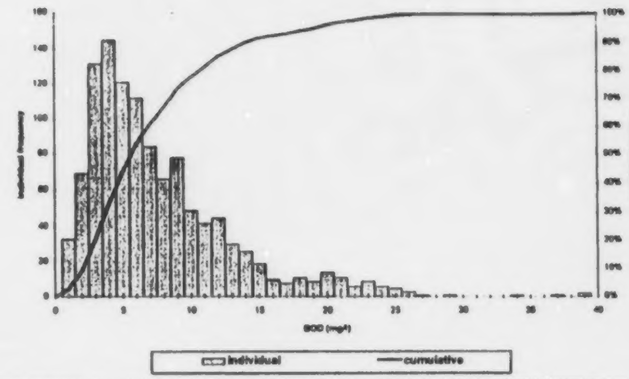
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution (in mg/l)
Gold Bar (Edmonton): 1990-1995



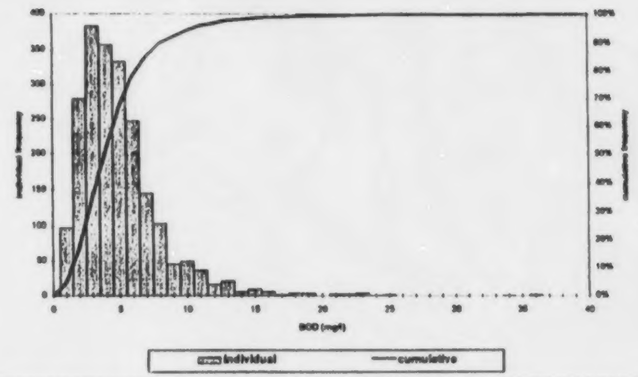
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution (in mg/l)
Capital Region (Metro Edmonton): 1990-1995

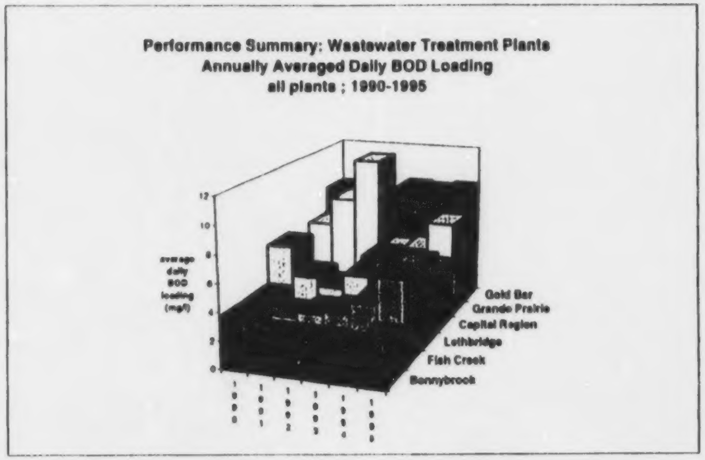


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution (in mg/l)
Grande Prairie: 1990-1995



Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily BOD Loading - Frequency Distribution (in mg/l)
Lethbridge: 1990-1995




Performance Summary: Wastewater Treatment Plants
Annually Averaged Daily BOD Loading
all plants ; 1990-1995

average daily BOD loading (mg/l):

		Bonnybrook	Fish Creek	Gold Bar	Capital Region	Grande Prairie	Lethbridge
total samples 1990-1995:		2189	2190	2191	2188	1151	2176
average for:	1990	3.73	3.75	8.58	3.15	6.55	6.70
	1991	2.46	2.81	7.86	2.65	8.63	4.58
	1992	2.49	3.24	7.83	2.16	11.79	3.93
	1993	2.45	3.50	8.97	5.38	4.96	5.02
	1994	2.29	4.35	8.81	5.02	5.17	3.99
	1995	3.19	6.32	8.97	4.72	7.27	6.18
	1990-1995	2.77	4.00	8.50	3.85	7.33	5.07

note:

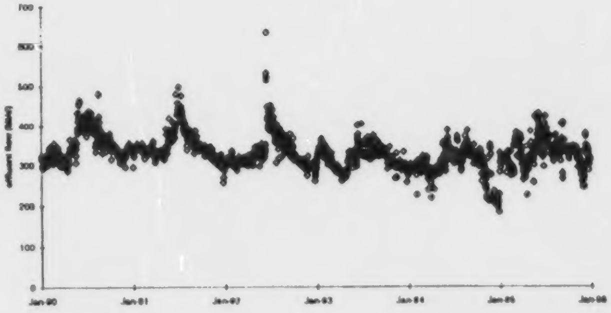
Grande Prairie is a batch operation

BOD: calculated annual average (x) and sample standard deviation (s) for each facility : 1990-1995

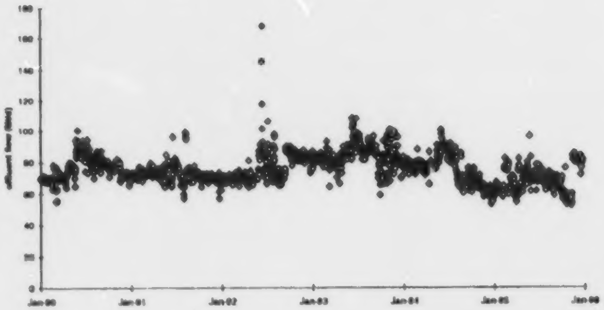
	1990		1991		1992		1993		1994		1995		1995 imposed limits (mg/l):	
mill	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	daily	monthly
Bonnybrook	3.7	1.4	2.5	1.2	2.5	0.9	2.4	1.0	2.3	0.9	3.2	1.8	n/a	20
Fish Creek	3.8	1.8	2.8	1.7	3.2	1.9	3.5	1.4	4.4	2.0	6.3	2.7	n/a	20
Gold Bar	8.6	4.2	7.9	3.1	7.8	2.4	9.0	3.9	8.8	4.6	9.0	2.9	n/a	25
Capital Region	3.1	1.7	2.7	1.6	2.2	1.1	5.4	3.1	5.0	2.6	4.7	2.5	n/a	20
Grande Prairie	6.6	3.6	8.6	4.8	11.8	8.4	5.0	4.2	5.2	4.6	7.3	4.7	n/a	20
Lethbridge	6.7	4.7	4.6	3.4	3.9	2.5	5.0	3.5	4.0	3.0	6.2	3.2	n/a	20

Effluent Flow

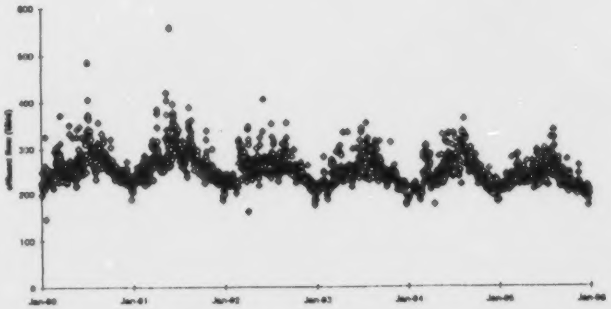
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Time Series
Bonnybrook (Calgary): 1990-1995



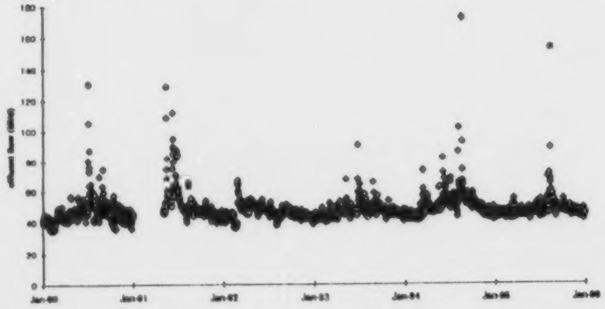
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Time Series
Fish Creek (Calgary): 1990-1995



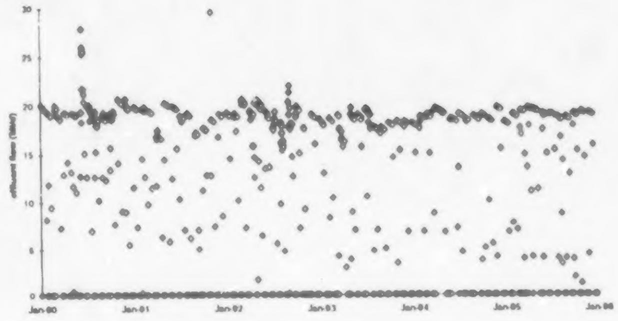
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Time Series
Gold Bar (Edmonton): 1990-1995



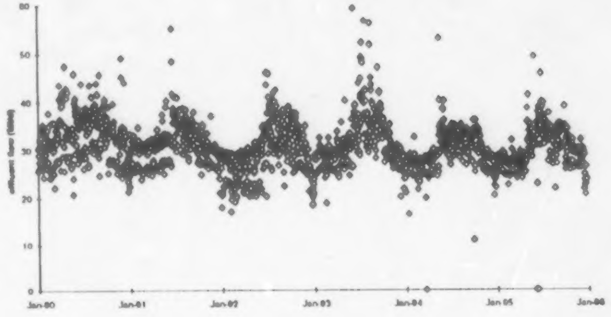
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Time Series
Capital Region (Metro Edmonton): 1990-1995

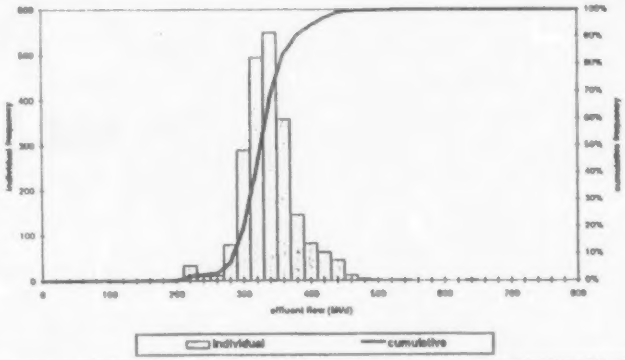


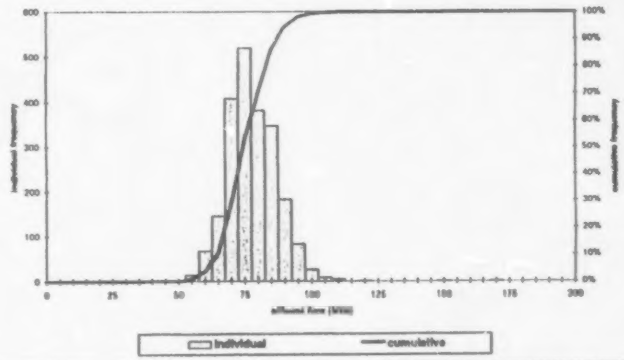
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Time Series
Grande Prairie: 1990-1995

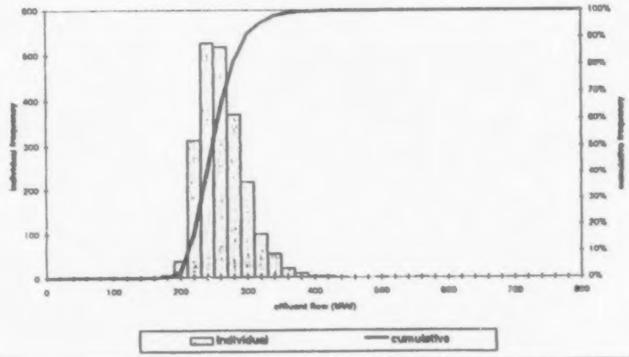


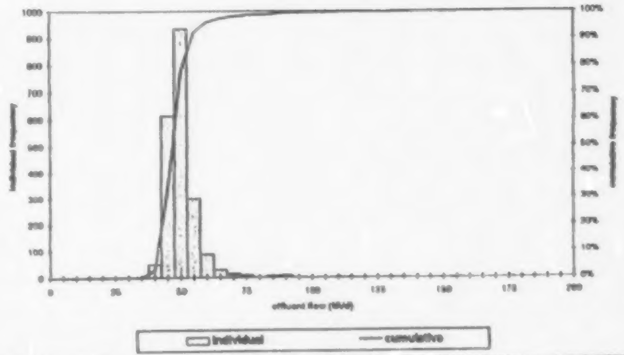
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Time Series
Lethbridge: 1990-1995



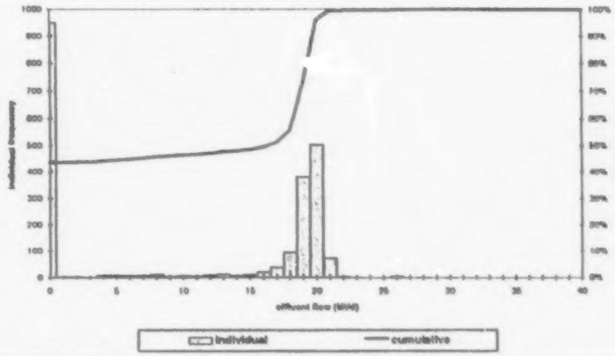

Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Frequency Distribution
Bonnybrook (Calgary): 1990-1995


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Frequency Distribution
Fish Creek (Calgary): 1990-1995

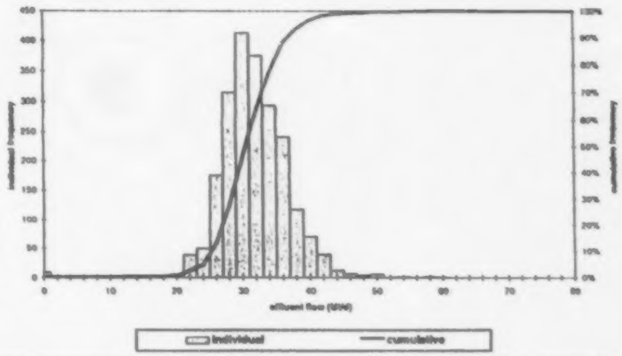

Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Frequency Distribution
Gold Bar (Edmonton): 1990-1995

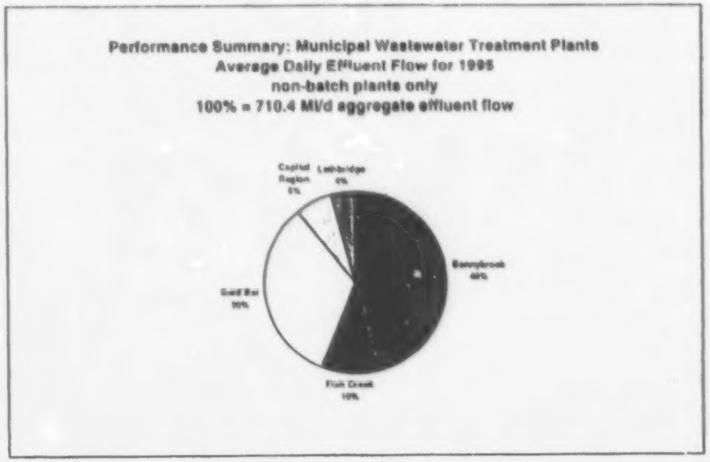

Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Frequency Distribution
Capital Region (Metro Edmonton): 1990-1995

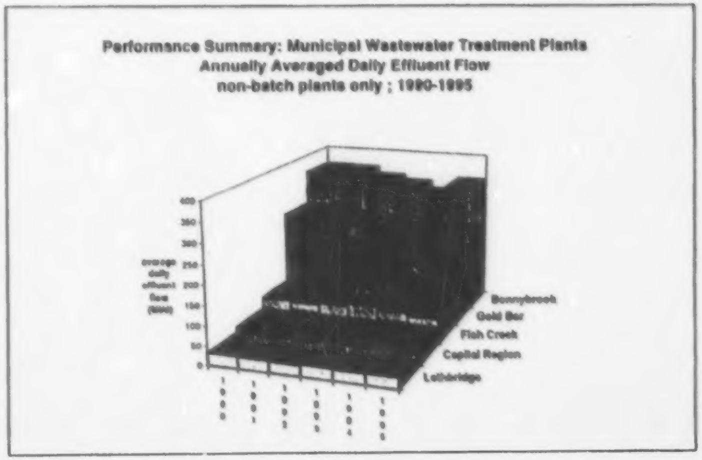
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Frequency Distribution
Grande Prairie: 1990-1995



Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Effluent Flow - Frequency Distribution
Lethbridge: 1990-1995




Performance Summary: Municipal Wastewater Treatment Plants
Average Daily Effluent Flow for 1995
non-batch plants only
100% = 710.4 Ml/d aggregate effluent flow


Performance Summary: Municipal Wastewater Treatment Plants
Annually Averaged Daily Effluent Flow
non-batch plants only ; 1990-1995

calculation of aggregate (non-batch plants only) (Ml/d):

aggregate (Ml/d):

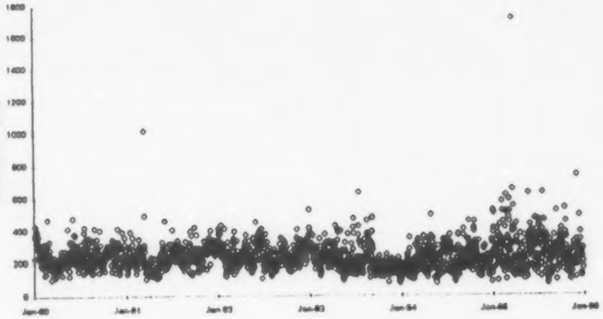
		Bonnybrook	Fish Creek	Gold Bar	Capital Region	Grande Prairie	Lethbridge	all
total samples 1990-1995:		2191	2191	2191	2071	2188	2191	13023
average for:	1990	351.55	76.11	262.93	46.86		33.13	770.58
	1991	349.54	72.28	272.46	51.66		31.23	777.17
	1992	330.96	76.81	253.97	46.22		29.33	737.29
	1993	317.68	83.80	245.67	47.08		31.78	726.02
	1994	297.56	74.56	245.60	50.51		29.53	697.96
	1995	330.36	68.16	234.97	47.32		29.56	710.37
	1990-1995	329.61	75.29	252.64	48.08		30.76	736.37

effluent flow: ***calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995***

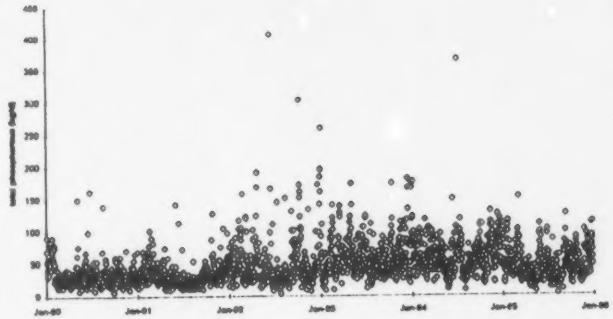
mill	1990 x (Ml/d)	s (Ml/d)	1991 x (Ml/d)	s (Ml/d)	1992 x (Ml/d)	s (Ml/d)	1993 x (Ml/d)	s (Ml/d)	1994 x (Ml/d)	s (Ml/d)	1995 x (Ml/d)	s (Ml/d)	1995 imposed limits (Ml/d): daily	monthly
Bonnybrook	351.55	30.70	349.54	35.76	330.96	42.50	317.68	25.76	297.56	30.12	330.36	32.96	-	-
Fish Creek	76.11	7.07	72.28	4.62	76.81	10.05	83.80	7.40	74.56	9.01	68.16	7.77	-	-
Gold Bar	262.93	36.12	272.46	40.37	253.97	30.34	245.67	29.44	245.60	35.16	234.97	25.06	-	-
Capital Region	46.86	8.41	51.66	12.12	46.22	4.07	47.08	4.73	50.51	9.75	47.32	7.07	-	-
Grande Prairie	10.44	0.53	9.96	0.22	9.37	0.33	9.96	0.86	10.02	0.30	10.78	0.34	-	-
Lethbridge	33.13	4.96	31.23	3.81	29.33	5.26	31.78	5.83	29.53	4.08	29.56	6.11	-	-

Phosphorous

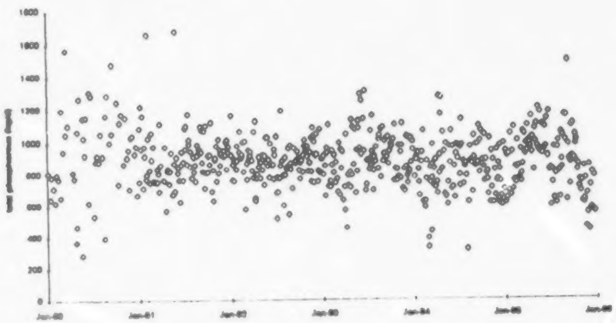
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series
Bonnybrook (Calgary): 1990-1995



Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series
Fish Creek (Calgary): 1990-1995

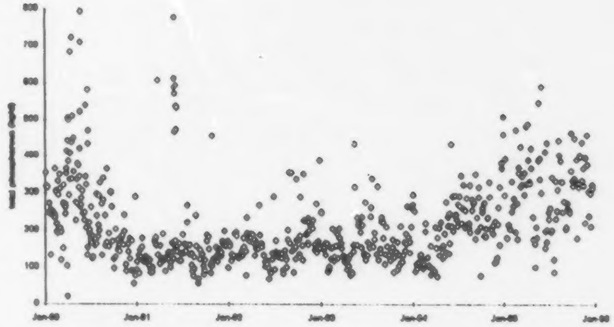


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series
Gold Bar (Edmonton): 1990-1995



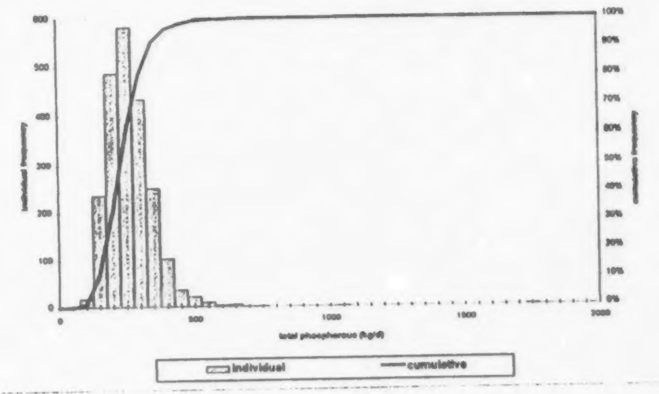
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series
Capital Region (Metro Edmonton): 1990-1995

Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series
Grande Prairie: 1990-1996

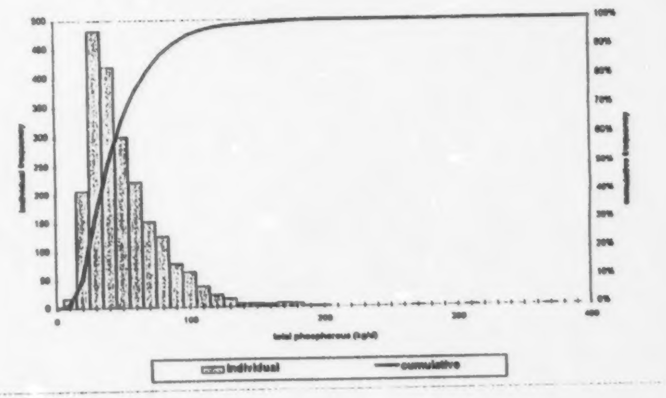


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series
Lethbridge: 1990-1996

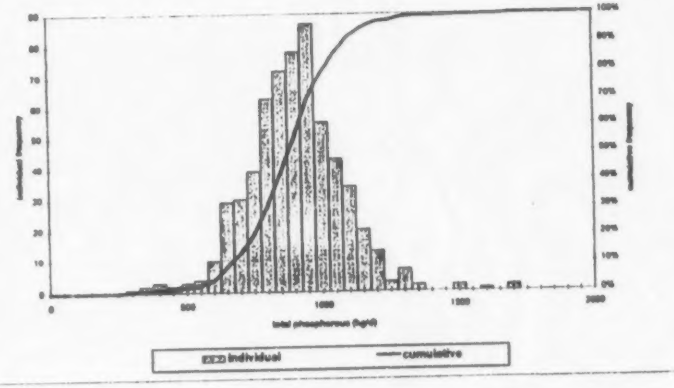
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution
Bonnybrook (Calgary): 1990-1995



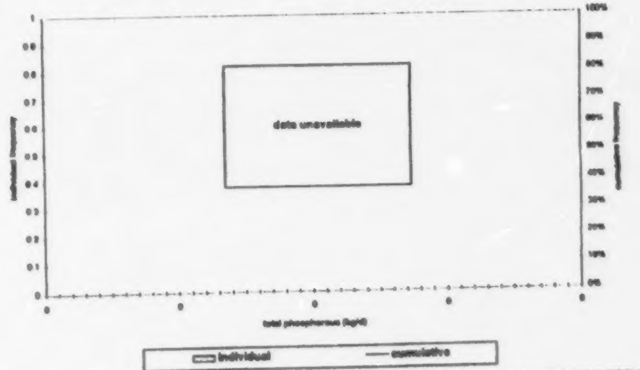
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution
Fish Creek (Calgary): 1990-1995



Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution
Gold Bar (Edmonton): 1990-1995

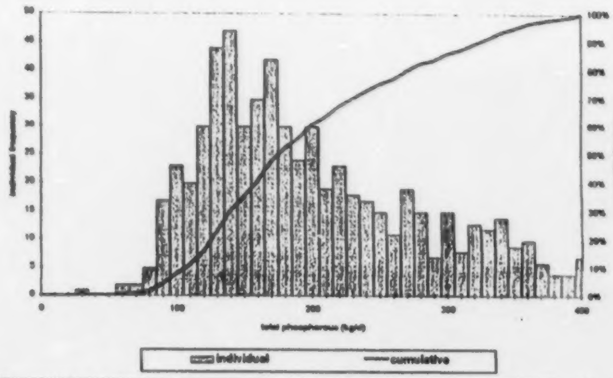


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution
Capital Region (Metro Edmonton): 1990-1995

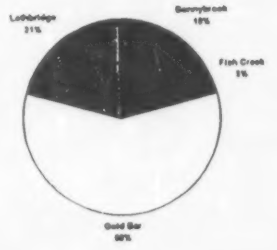


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution
Grande Prairie: 1990-1996

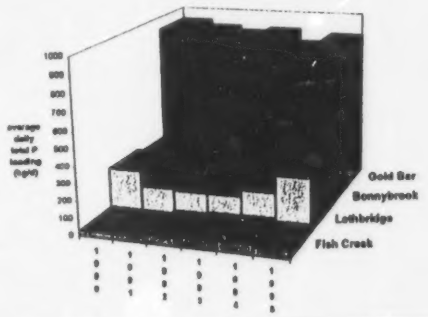
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution
Lethbridge: 1990-1996



Performance Summary: Municipal Wastewater Treatment Plants
Average Daily Total Phosphorous Loading for 1995
non-batch plants only
100% = 1502.4 kg/d aggregate total P loading



Performance Summary: Municipal Wastewater Treatment Plants
Annually Averaged Daily Total Phosphorous Loading
non-batch plants only ; 1990-1995



calculation of aggregate (non-batch plants only) (kg/d):

		Bonnybrook	Fish Creek	Gold Bar	Capital Region	Grande Prairie	Lethbridge
total samples 1990-1995:		2191	2190	605	0	0	678
average for:	1990	244.78	33.20	927.72	-		269.60
	1991	242.28	32.18	898.94	-		177.20
	1992	250.10	50.76	874.22	-		167.80
	1993	217.55	58.91	895.01	-		167.39
	1994	216.12	61.07	821.88	-		207.22
	1995	271.33	46.66	874.00	-		310.44
	1990-1995	240.36	47.14	876.97	-		216.34

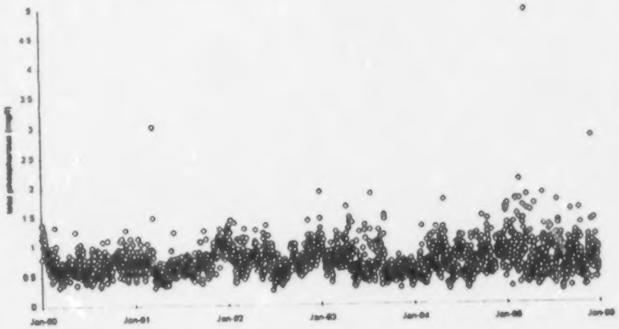
aggregate (kg/d):

all
5664
1475.30
1350.61
1342.88
1338.86
1306.30
1502.44
1382.81

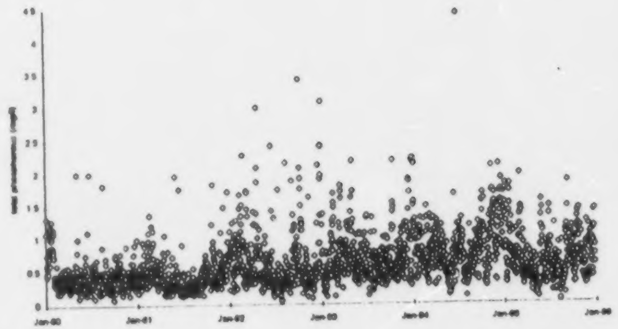
total P: ***calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995***

mill	1990 x (kg/d)	s (kg/d)	1991 x (kg/d)	s (kg/d)	1992 x (kg/d)	s (kg/d)	1993 x (kg/d)	s (kg/d)	1994 x (kg/d)	s (kg/d)	1995 x (kg/d)	s (kg/d)	1995 imposed limits (kg/d): daily	monthly
Bonnybrook	244.78	68.76	242.28	76.50	250.10	67.70	217.55	77.78	216.12	73.28	271.33	134.83	-	-
Fish Creek	33.20	10.62	32.18	17.96	50.76	42.74	58.91	30.13	61.07	30.18	46.66	24.20	-	-
Gold Bar	927.72	272.56	898.94	169.35	874.22	119.29	895.01	182.05	821.88	171.91	874.00	183.68	-	-
Capital Region	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grande Prairie	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lethbridge	269.60	133.81	177.20	134.18	167.80	60.09	167.39	89.16	207.22	78.14	310.44	100.92	-	-

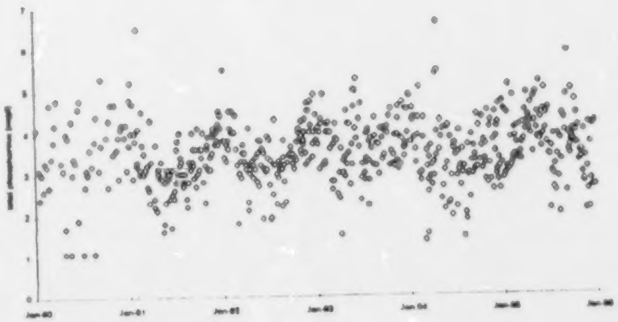
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series (in mg/l)
Bonnybrook (Calgary): 1990-1996



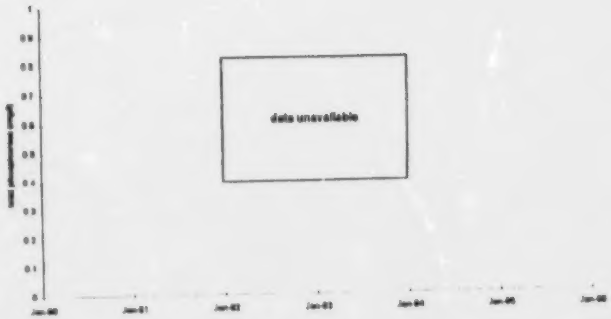
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series (in mg/l)
Fish Creek (Calgary): 1990-1996



Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series (in mg/l)
Gold Bar (Edmonton): 1990-1996

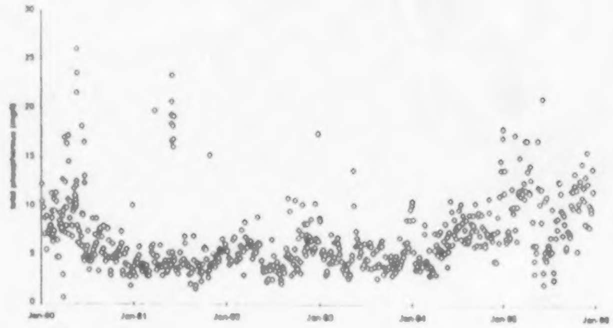


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series (in mg/l)
Capital Region (Metro Edmonton): 1990-1996

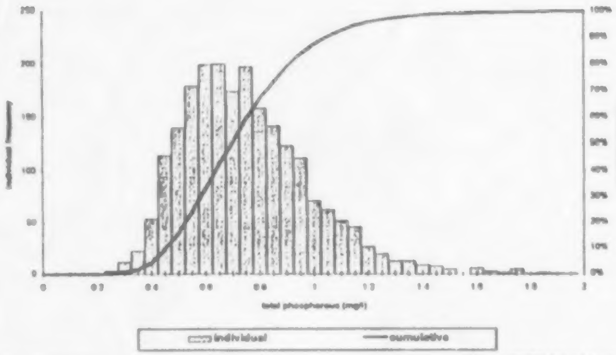


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series (in mg/l)
Grande Prairie: 1990-1996

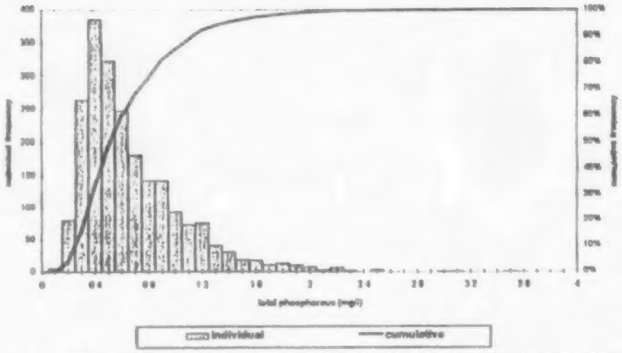
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Time Series (in mg/l)
Lethbridge: 1990-1995



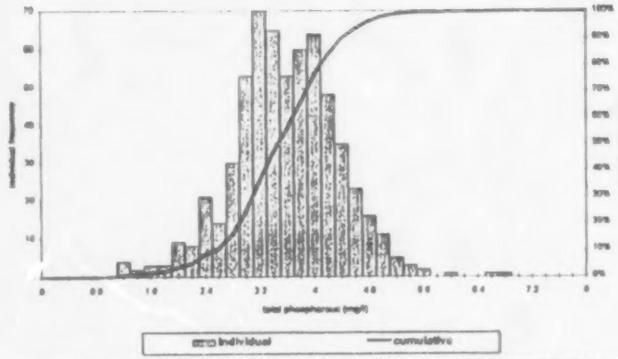
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution (in mg/l)
Bonnybrook (Calgary): 1990-1995



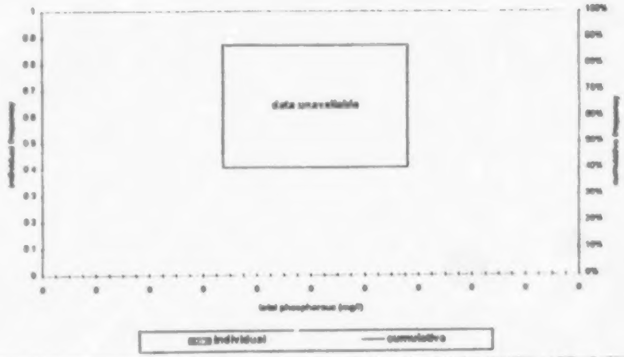
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution (in mg/l)
Fish Creek (Calgary): 1990-1995



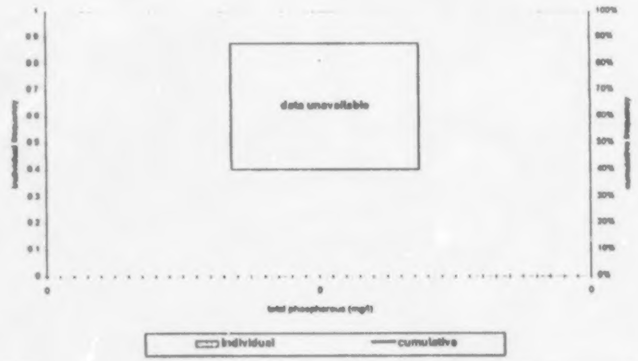
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution (in mg/l)
Gold Bar (Edmonton): 1990-1995



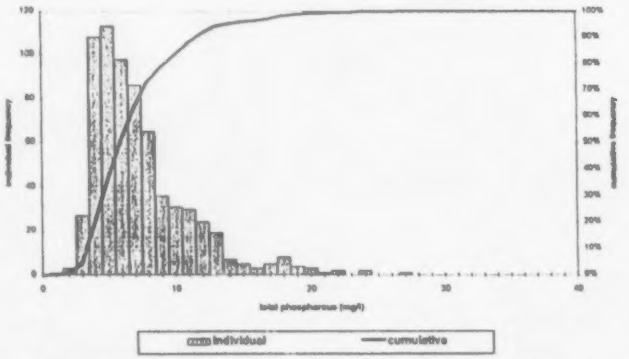
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution (in mg/l)
Capital Region (Metro Edmonton): 1990-1995

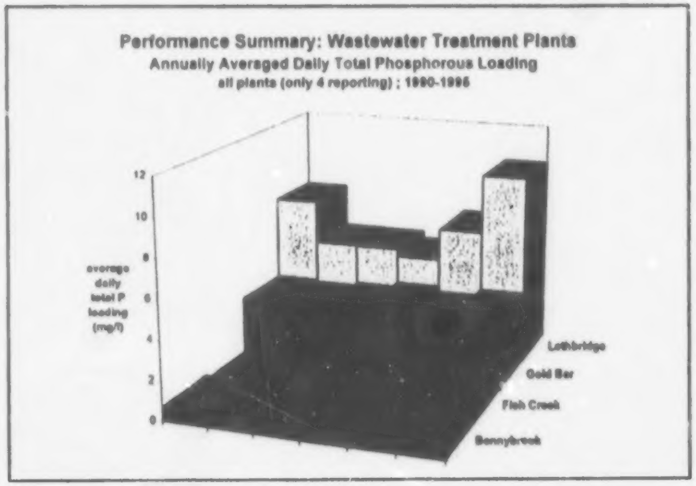


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution (in mg/l)
Grande Prairie: 1990-1996



Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily Total Phosphorous Loading - Frequency Distribution (in mg/l)
Lethbridge: 1990-1996




Performance Summary: Wastewater Treatment Plants
Annually Averaged Daily Total Phosphorous Loading
all plants (only 4 reporting) ; 1990-1995

average daily total P loading (mg/l):

		Bonnybrook	Fish Creek	Gold Bar	Capital Region	Grande Prairie	Lethbridge
total samples 1990-1995:		2191	2190	606	0	0	682
average for:	1990	0.70	0.44	3.41	-	-	7.89
	1991	0.70	0.46	3.30	-	-	6.60
	1992	0.77	0.66	3.46	-	-	6.56
	1993	0.69	0.71	3.69	-	-	6.16
	1994	0.73	0.83	3.39	-	-	6.90
	1995	0.82	0.69	3.73	-	-	10.02
	1990-1995	0.73	0.63	3.51	-	-	6.89

note:

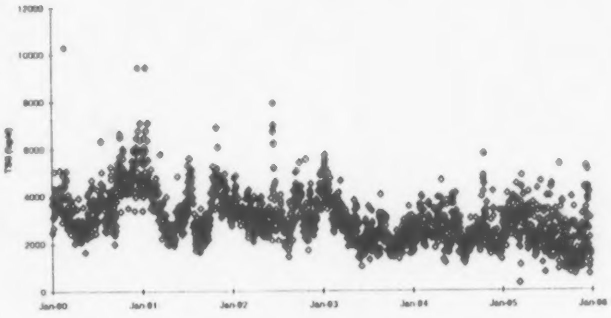
Grande Prairie is a batch operation

total P: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

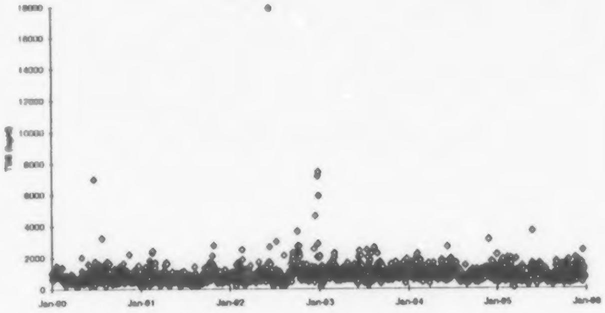
mill	1990 x (mg/l)	s (mg/l)	1991 x (mg/l)	s (mg/l)	1992 x (mg/l)	s (mg/l)	1993 x (mg/l)	s (mg/l)	1994 x (mg/l)	s (mg/l)	1995 x (mg/l)	s (mg/l)	1995 imposed limits (mg/l): daily	monthly
Bonnybrook	0.7	0.2	0.7	0.2	0.8	0.2	0.7	0.2	0.7	0.2	0.8	0.4	-	1
Fish Creek	0.4	0.2	0.4	0.3	0.7	0.6	0.7	0.4	0.8	0.4	0.7	0.3	-	-
Gold Bar	3.4	1.0	3.3	0.8	3.5	0.6	3.7	0.7	3.4	0.9	3.7	0.7	-	-
Capital Region	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grande Prairie	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lethbridge	7.9	4.0	6.6	4.4	6.6	3.3	6.1	1.8	6.9	2.3	10.0	3.7	-	-

Total Suspended Solids
(TSS)

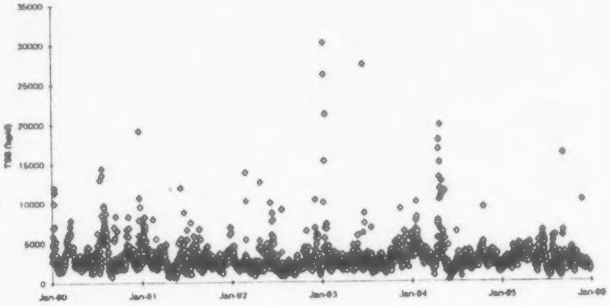
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series
Bonnybrook (Calgary): 1990-1995



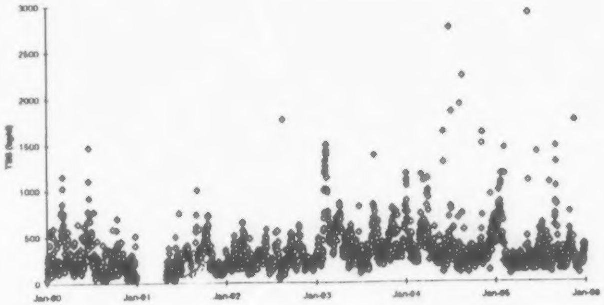
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series
Fish Creek (Calgary): 1990-1995



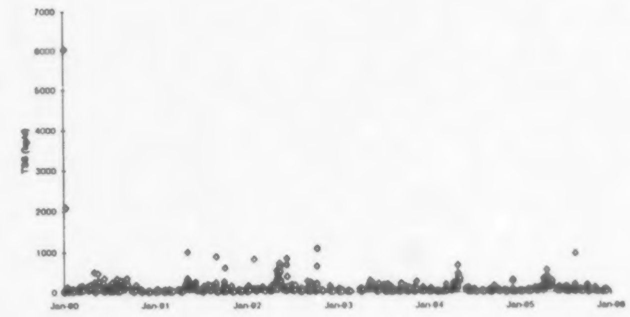
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series
Gold Bar (Edmonton): 1990-1995



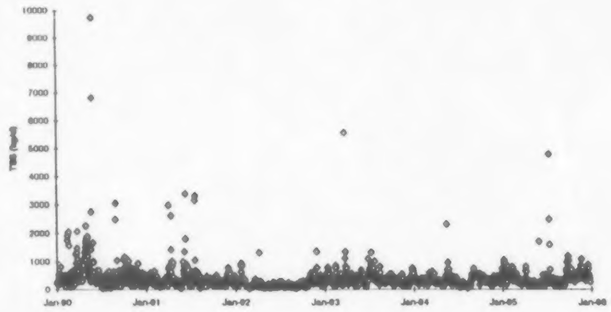
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series
Capital Region (Metro Edmonton): 1990-1995

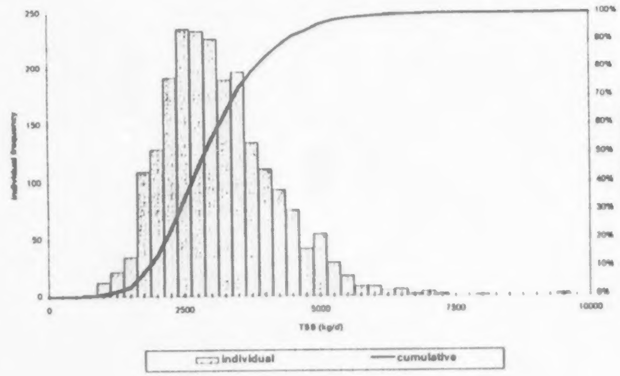


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series
Grande Prairie: 1990-1995

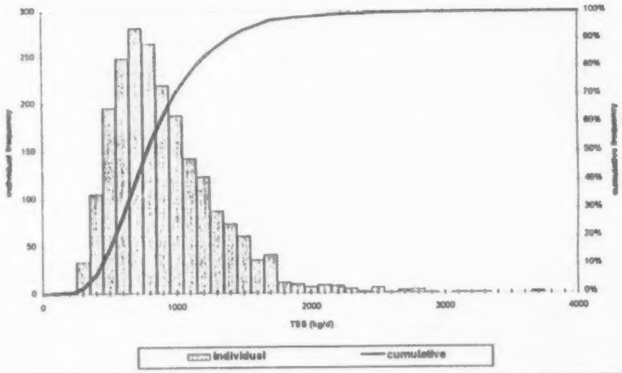


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series
Lethbridge: 1990-1995

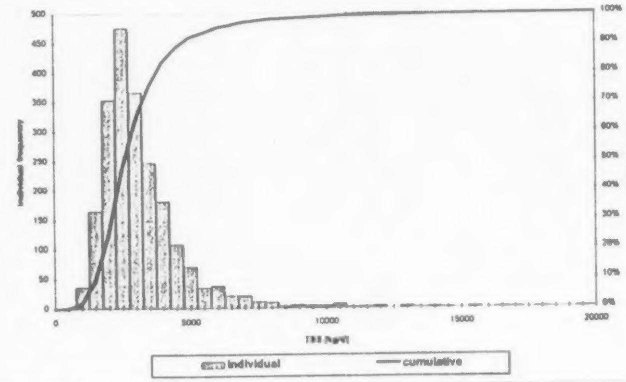




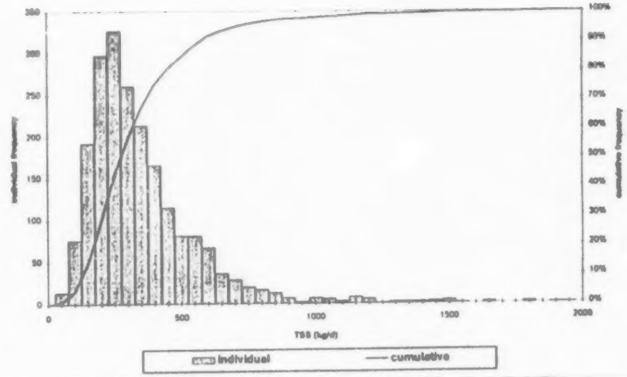
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution
Bonnybrook (Calgary): 1990-1995



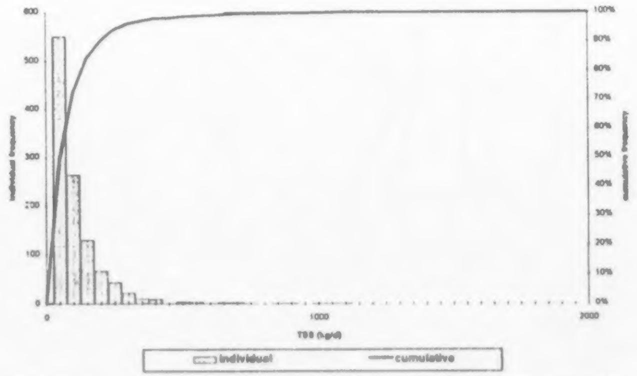
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution
Fish Creek (Calgary): 1990-1995

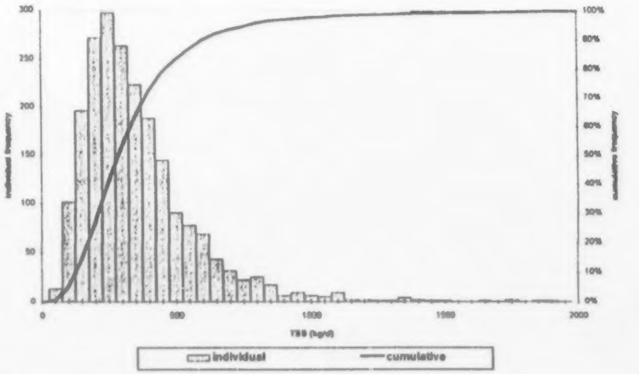


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution
Gold Bar (Edmonton): 1990-1995

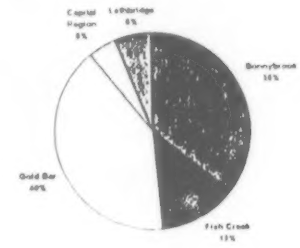


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution
Capital Region (Metro Edmonton): 1990-1995

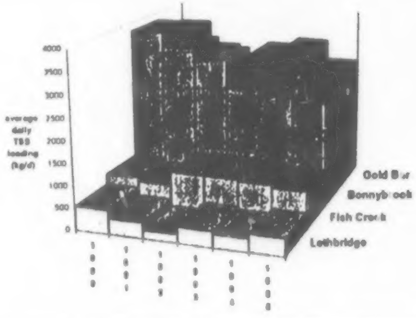

Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution
Grande Prairie: 1990-1995


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution
Lethbridge: 1990-1995

Performance Summary: Municipal Wastewater Treatment Plants
Average Daily TSS Loading for 1995
non-batch plants only
100% = 6885 kg/d aggregate TSS loading



Performance Summary: Municipal Wastewater Treatment Plants
Annually Averaged Daily TSS Loading
non-batch plants only ; 1990-1995



calculation of aggregate (non-batch plants only) (kg/d):

		Bonnybrook	Fish Creek	Gold Bar	Capital Region	Grande Prairie	Lethbridge
total samples 1990-1995:		2191	2191	2190	2071	1130	2179
average for:	1990	3816.34	784.83	3848.02	270.80		662.43
	1991	3478.01	696.46	3004.82	240.67		366.10
	1992	3274.47	1003.39	2657.51	266.77		199.62
	1993	2611.54	996.73	3098.64	442.45		370.89
	1994	2501.93	960.46	3284.91	408.88		311.21
	1995	2463.47	869.66	2789.64	340.62		411.68
	1990-1995	3022.91	856.79	3041.81	333.19		388.41

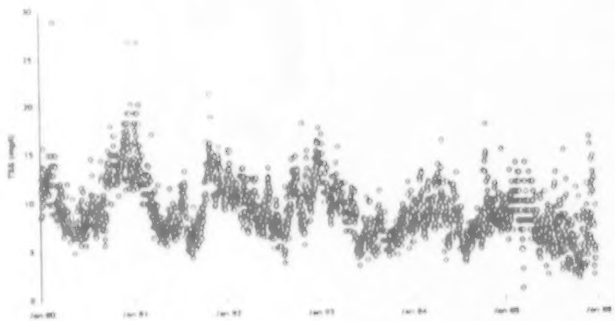
aggregate (kg/d):

all
11962
8972.42
7786.06
7300.77
7620.26
7427.10
6884.97
7653.11

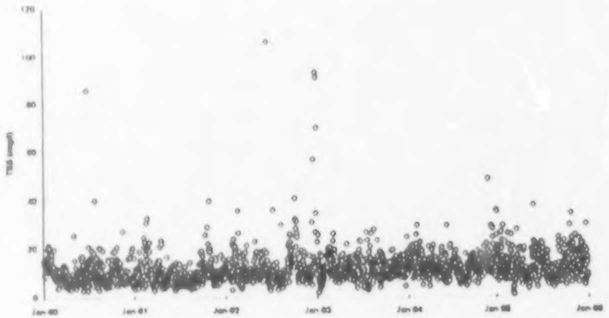
TSS: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1996 imposed limits (kg/d):	
mill	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Bonnybrook	3816.34	1087.35	3478.01	1082.26	3274.47	781.37	2611.54	818.84	2501.93	687.66	2463.47	898.42	-	-
Fish Creek	784.83	481.19	696.46	363.01	1003.39	1163.11	996.73	392.66	960.46	358.70	869.66	427.43	-	-
Gold Bar	3848.02	2216.38	3004.82	1478.90	2657.51	1899.18	3098.64	2843.03	3284.91	2337.79	2789.64	1304.04	-	-
Capital Region	270.80	189.85	240.67	182.49	266.77	146.08	442.45	228.17	408.88	294.78	340.62	274.94	-	-
Grande Prairie	143.20	482.27	89.78	122.84	136.19	174.87	67.03	62.90	70.93	96.78	82.80	100.63	-	-
Lethbridge	662.43	728.14	366.10	384.82	199.62	168.68	370.89	334.01	311.21	170.84	411.68	348.89	-	-

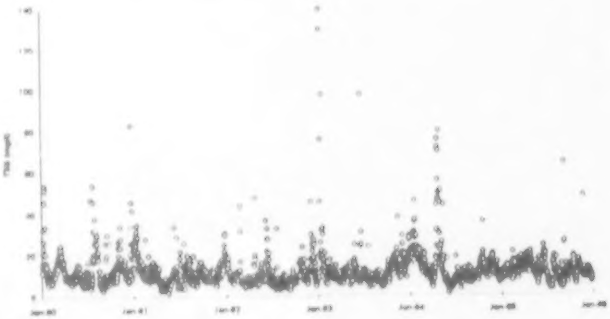
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series (in mg/l)
Bonnybrook (Calgary): 1990-1996



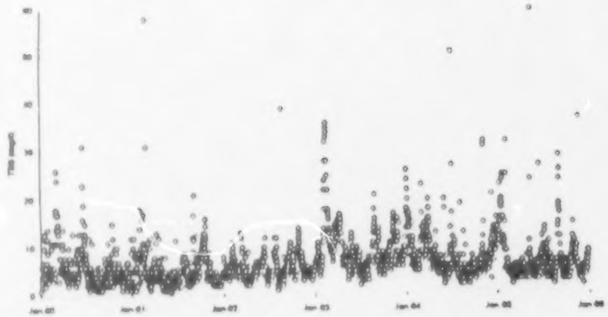
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series (in mg/l)
Fish Creek (Calgary): 1990-1996



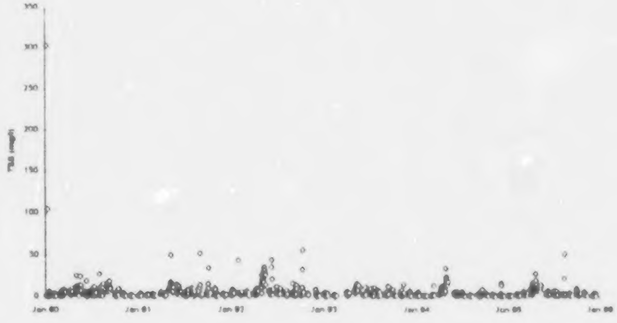
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series (in mg/l)
Gold Bar (Edmonton): 1990-1996



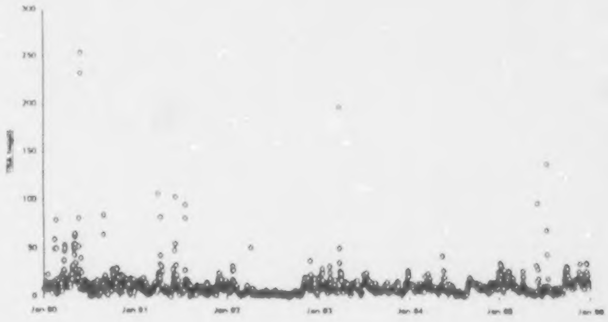
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series (in mg/l)
Capital Region (Metro Edmonton): 1990-1996



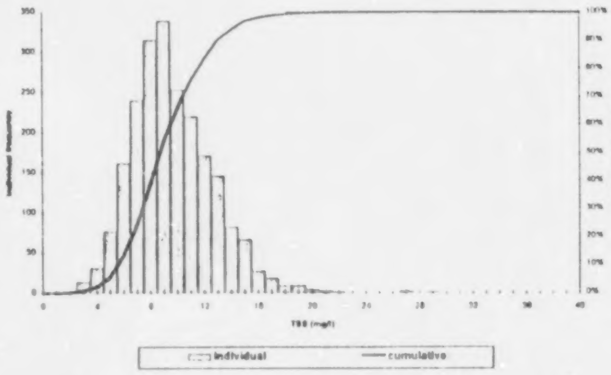
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series (in mg/l)
Grande Prairie 1990-1996



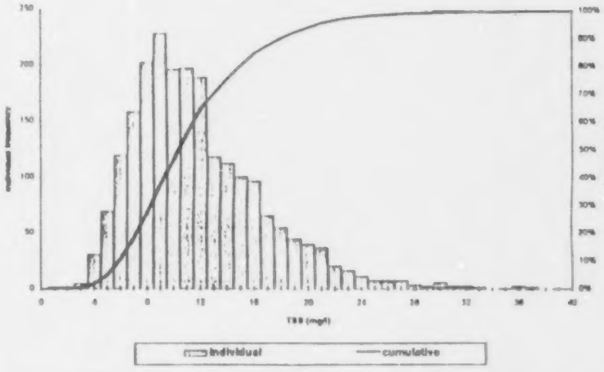
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Time Series (in mg/l)
Lethbridge: 1990-1996



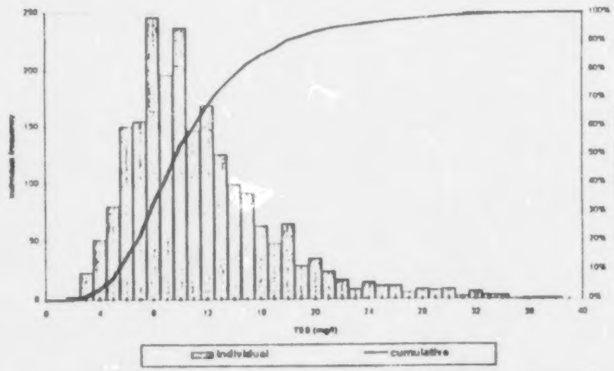
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution (in mg/l)
Bonnybrook (Calgary): 1990-1996



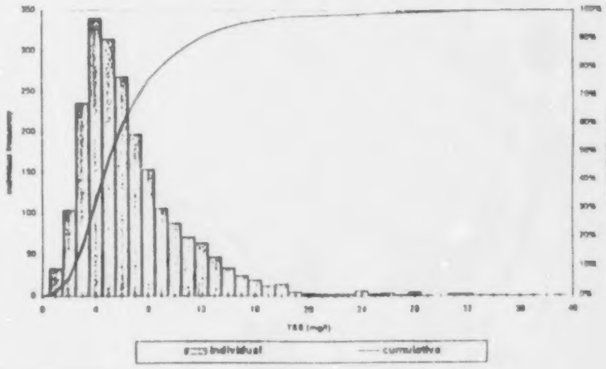
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution (in mg/l)
Fish Creek (Calgary): 1990-1996



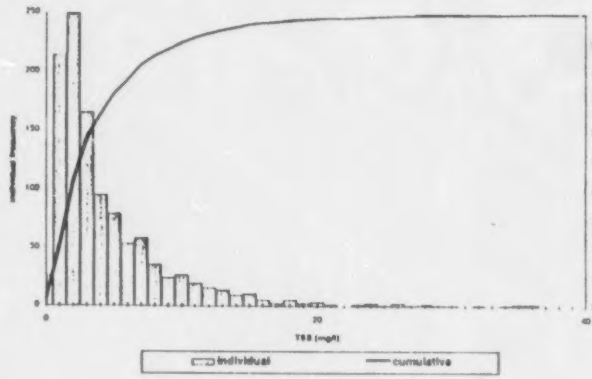
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution (in mg/l)
Gold Bar (Edmonton): 1990-1996



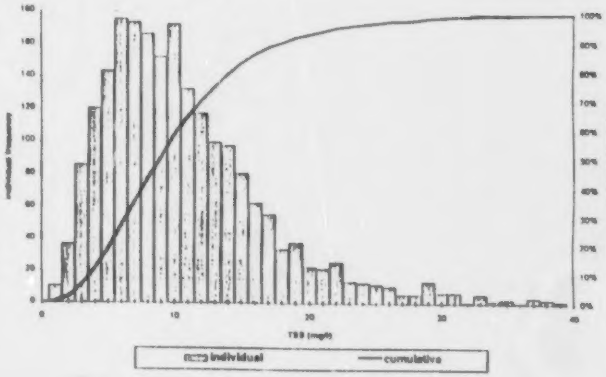
Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution (in mg/l)
Capital Region (Metro Edmonton): 1990-1996

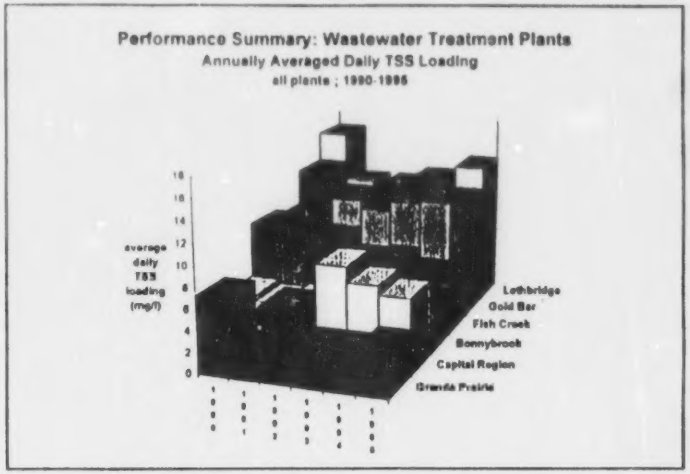


Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution (In mg/l)
Grande Prairie: 1990-1996



Performance Summary: Municipal Wastewater Treatment Plants
Individual Daily TSS Loading - Frequency Distribution (In mg/l)
Lethbridge: 1990-1996





Performance Summary: Wastewater Treatment Plants
Annually Averaged Daily TSS Loading
all plants ; 1990-1995

		average daily TSS loading (mg/l):					
		Bonnybrook	Fish Creek	Gold Bar	Capital Region	Grande Prairie	Lethbridge
total samples 1990-1995:		2191	2191	2190	2191	1167	2186
average for:	1990	10.96	10.27	13.71	5.64	7.37	16.64
	1991	10.05	9.64	11.26	5.42	4.68	11.65
	1992	10.00	12.61	10.15	5.74	7.02	8.96
	1993	8.25	11.87	12.95	9.53	3.66	11.72
	1994	8.47	12.81	13.73	8.08	3.68	10.51
	1995	7.48	13.08	11.62	7.22	4.40	14.01
	1990-1995	9.20	11.71	12.27	6.97	5.11	11.69

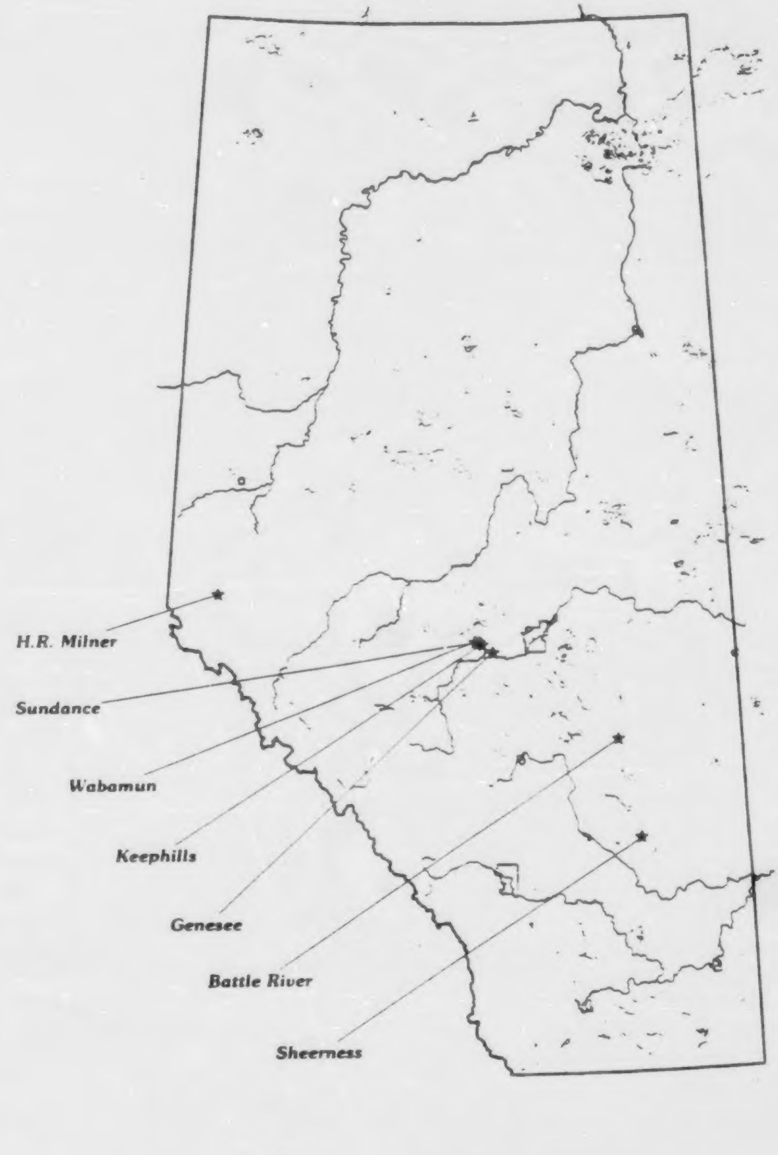
note:

Grande Prairie is a batch operation

TSS: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (mg/l):	
mill	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	x (mg/l)	s (mg/l)	daily	monthly
Bonnybrook	11.0	3.3	10.1	3.2	10.0	2.4	8.2	2.6	8.5	2.2	7.5	2.6	-	20
Fish Creek	10.3	6.0	9.6	4.9	12.6	10.4	11.9	4.4	12.8	4.8	13.1	6.0	-	20
Gold Bar	13.7	8.9	11.3	5.0	10.2	6.1	13.0	12.9	13.7	10.4	11.6	6.1	-	25
Capital Region	5.6	4.1	5.4	4.6	5.7	3.8	9.5	6.3	8.1	6.2	7.2	5.8	-	20
Grande Prairie	7.4	23.9	4.7	0.5	7.0	6.9	3.7	3.4	3.7	5.9	4.4	6.4	-	20
Lethbridge	16.6	21.2	11.6	11.8	9.0	5.7	11.7	11.4	10.5	4.7	14.0	11.4	-	20

Power Plants


H.R. Milner
Sundance
Wabamun
Keephills
Genesee
Battle River
Sheerness

Power Plants

General

Power plants extract raw water from a suitable local source (usually a river) and use it for cooling the turbines*. In most cases, the cooling water is recirculated through the plant repeatedly before it is returned to the environment, and thus it can become very hot. As well, some of the raw water is used periodically in sluicing the combustion chambers in the boilers, thereby cleansing them of accumulated coal-ash and residues while producing a wastewater of very high turbidity. Consequently, most coal-fired power plants in Alberta are constructed with large ponds lying adjacent to the plant. These ponds serve several important functions: they act as cooling ponds for the recirculating water, they act as settling ponds for the suspended ash, and they act as reservoirs or holding ponds so that variations in the rate at which effluent is discharged back to the receiving stream may be moderated. In Alberta, nearly every coal-fired power plant recirculates its water in this manner - only the Wabamun plant practices direct flow-through.

Currently, there are ten active power plants in Alberta, of which seven are approved for discharge:

Power Plants General Information

plant	receiving stream	location	capacity (MW)	opened
Wabamun	Lake Wabamun	Wabamun	580	pre-1990
Sundance	North Saskatchewan River	Wabamun	2122	pre-1990
Keephills	North Saskatchewan River	Wabamun	810	pre-1990
Battle River	Battle River	Forestburg	735	pre-1990
H. R. Milner	Smoky River	Grande Cache	150	pre-1990
Sheerness	Red Deer River**	Hanna	820	pre-1990

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* Untreated river water is not used in the turbines or boilers.

** the Sheerness generating station does not actually discharge directly into the Red Deer River. Instead, effluent from the cooling pond is released into an irrigation ditch which then distributes the effluent flow into both Bullpound Creek and Berry Creek - both of these are tributaries of the Red Deer River.

plant	receiving stream	location	capacity (MW)	opened
Genesee[***]	North Saskatchewan River	Genesee	820	pre-1990

Monitoring

Seventeen separate discharge monitoring requirements have been defined for this sector, of which six are included in this report: chlorine, iron, total nitrogen, total phosphorous, TSS and flow. It should be noted that some of these plants have reported chlorine as *free available* while others report it as free residual. The imposed effluent discharge limits for each of these plants are summarized in the following table:

Power Plants Mandated Effluent Limits

power plant	parameter	1995 daily limit (kg/d)	1995 monthly limit (kg/d)
Wabamun	chlorine residual	none	none
	iron	50	25
	total nitrogen	not applicable	not applicable
	total phosphorous	6.4	3.2
	TSS	1130 (net)	576 (net)
Sundance	chlorine residual	11	5.6
	iron	110	56
	total nitrogen	not applicable	not applicable
	total phosphorous	110	56
	TSS[**]	2750 (net)	1430 (net)
Keephills[***]	chlorine residual	18.6	9.3

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[*] Edmonton Power's Genesee plant has now been operating for several years, but apparently there is considerable excess capacity available for holding the cooling water as Genesee has yet to release its first discharge into the North Saskatchewan River.

[**] Pursuant to the terms of its approval, TSS monitoring data for the Sundance generating station are reported as net mass loadings (kg/d), *not* as absolute mass loadings (kg/d).

[***] batch operation

	iron	185	93
	total nitrogen	not applicable	not applicable
	total phosphorous	186	95
	TSS[*]	4650	2325
Battle River	chlorine residual	none	none
	iron	16	8
	total nitrogen	not applicable	not applicable
	total phosphorous	not applicable	not applicable
	TSS	2400	1050
H.R. Milner	chlorine residual	1.2	0.6
	iron	12	6
	total nitrogen	not applicable	not applicable
	total phosphorous	12	6
	TSS	300	150
Sheerness[**]	chlorine residual	none	none
	iron	647	263
	total nitrogen	558	275
	total phosphorous	not applicable	not applicable
	TSS	9245	3750
Genesee[***]	chlorine residual	none	none
	iron	226	113
	total nitrogen	not applicable	not applicable
	total phosphorous	226	113
	TSS	5650	2825

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[*] Pursuant to the terms of its approval, TSS monitoring data for the Keephills generating station are reported as net mass loadings (kg/d), *not* as absolute mass loadings (kg/d).

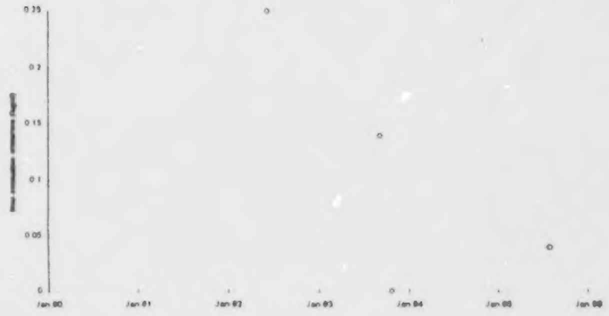
[**] batch operation

[***] batch operation

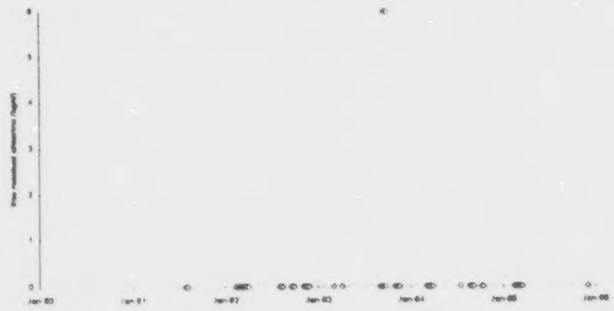
Chlorine

Performance Summary: Power Plants
Individual Daily Chlorine Loading - Time Series
Battle River Generating Station: 1990-1995

Performance Summary: Power Plants
Individual Daily Chlorine Loading - Time Series
H.R. Milner Generating Station: 1990-1995

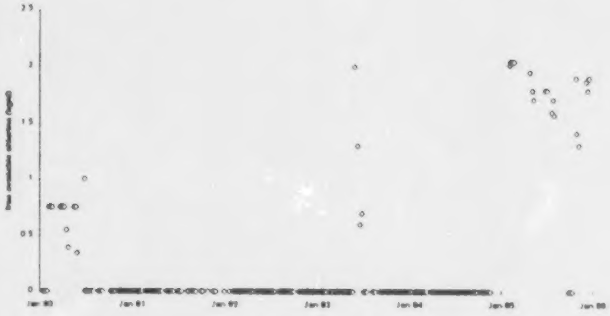


Performance Summary: Power Plants
Individual Daily Chlorine Loading - Time Series
Keephills Generating Station: 1990-1995



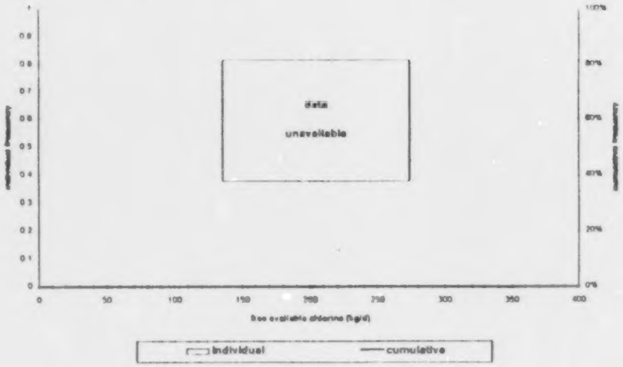
Performance Summary: Power Plants
Individual Daily Chlorine Loading - Time Series
Sheerness Generating Station: 1990-1995

Performance Summary: Power Plants
Individual Daily Chlorine Loading - Time Series
Sundance Generating Station: 1990-1996

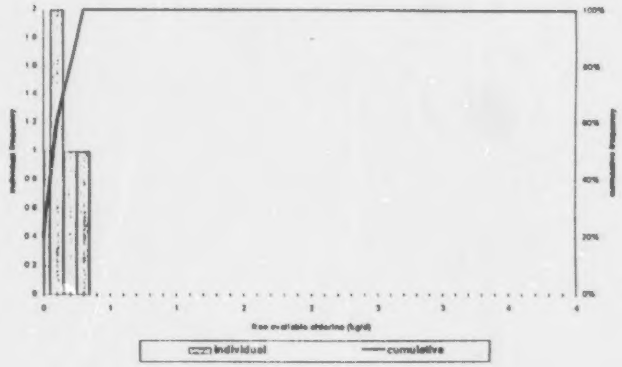


Performance Summary: Power Plants
Individual Daily Chlorine Loading - Time Series
Wabamun Generating Station: 1990-1996

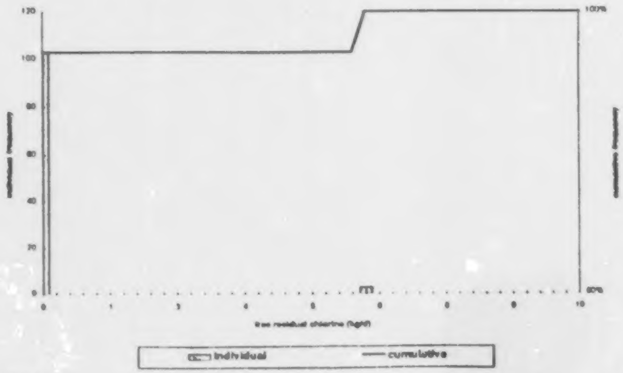
Performance Summary: Power Plants
Individual Daily Chlorine Loading - Frequency Distribution
Battle River Generating Station: 1990-1995



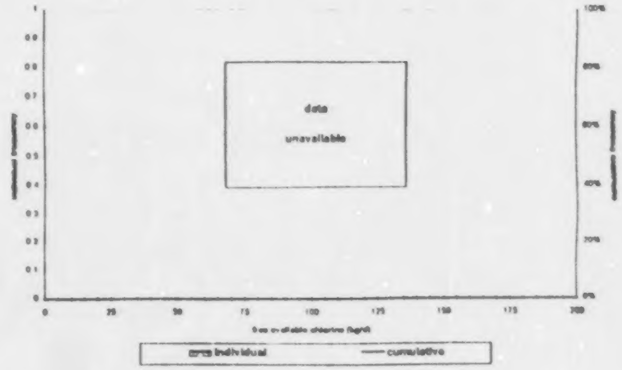
Performance Summary: Power Plants
Individual Daily Chlorine Loading - Frequency Distribution
H.R. Milner Generating Station: 1990-1995



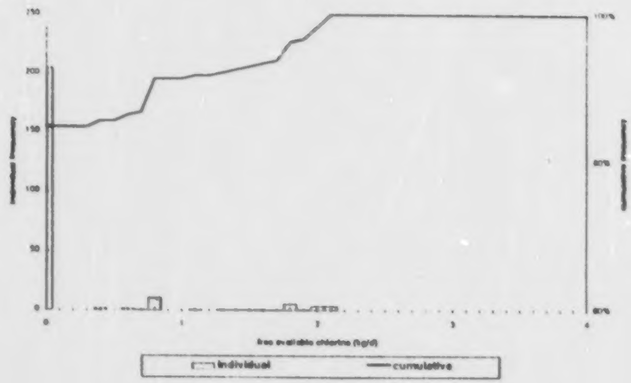
Performance Summary: Power Plants
Individual Daily Chlorine Loading - Frequency Distribution
Keephills Generating Station: 1990-1995



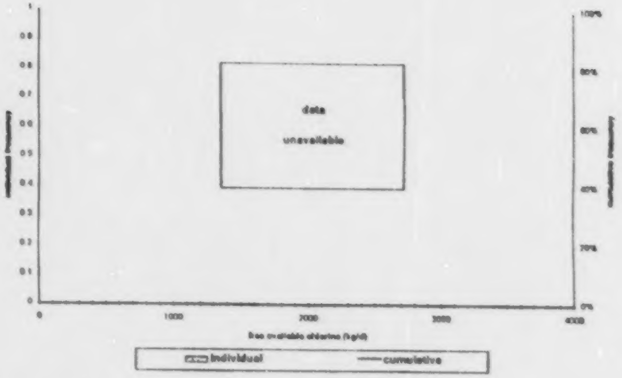
Performance Summary: Power Plants
Individual Daily Chlorine Loading - Frequency Distribution
Sheerness Generating Station: 1990-1995



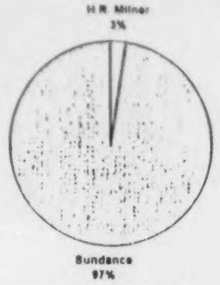
Performance Summary: Power Plants
Individual Daily Chlorine Loading - Frequency Distribution
Sundance Generating Station: 1990-1996



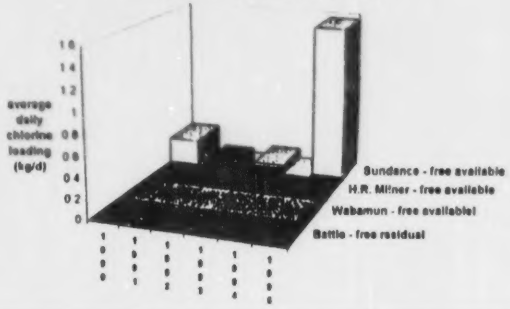
Performance Summary: Power Plants
Individual Daily Chlorine Loading - Frequency Distribution
Wabamun Generating Station: 1990-1996



Performance Summary: Power Plants
Average Daily Chlorine Loading for 1995
non-batch facilities only
100% = 1.6 kg/d aggregate chlorine loading



Performance Summary: Power Plants
Annually Averaged Daily Chlorine Loading
non-batch facilities only ; 1990-1995



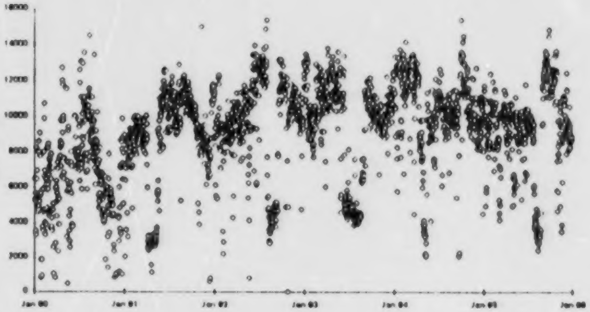
[illegible]	*calculation of aggregate (non-batch and non-net plants only) (kg/d):*						*aggregate (kg/d):*
	Battle	**H.R. Milner**	**Keephills**	**Sheerness**	**Sundance**	**Wabamun**	**all**
mode of operation:	continuous	continuous	batch	batch	continuous	continuous	[illegible]
total samples 1990-1995:	0	5	106	0	242	0	
average for: 1990	-	-			0.25	-	0.25
1991	-	-			0.00	-	0.00
1992	-	0.25			0.00	-	0.25
1993	-	0.07			0.09	-	0.16
1994	-	-			0.00	-	0.00
1995	-	0.04			1.64	-	1.58
1990-1995	-	0.09			0.20	-	0.29

chlorine: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

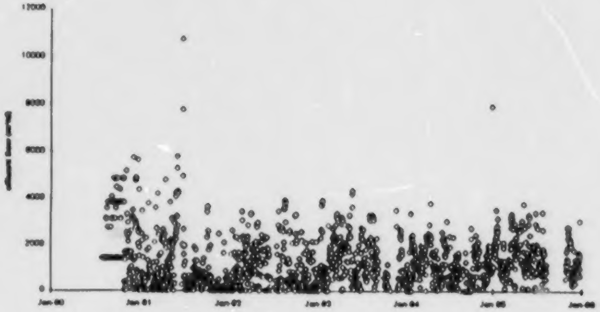
	1990		1991		1992		1993		1994		1995		1996 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily (kg/d)	monthly (kg/d)
Battle	-	-	-	-	-	-	-	-	-	-	-	-	none	none
H.R. Milner	-	-	-	-	0.25	-	0.07	0.098994949	-	-	0.04	0	1.2	0.6
Keephills	-	-	0	0	0	0	0.947368421	2.247805948	0	0	0	0	18.6	9.3
Sheerness	-	-	-	-	-	-	-	-	-	-	-	-	none	none
Sundance	0.250714286	0.353300762	0	0	0	0	0.093877551	0.356725947	0	0	1.542380952	0.674543585	11.0	5.6
Wabamun	-	-	-	-	-	-	-	-	-	-	-	-	none	none

Effluent Flow

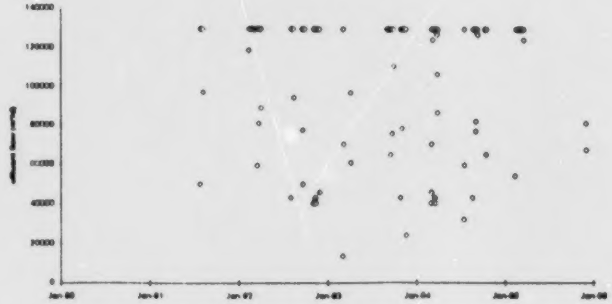
Performance Summary: Power Plants
Individual Daily Effluent Flow - Time Series
Battle River Generating Station: 1990-1996



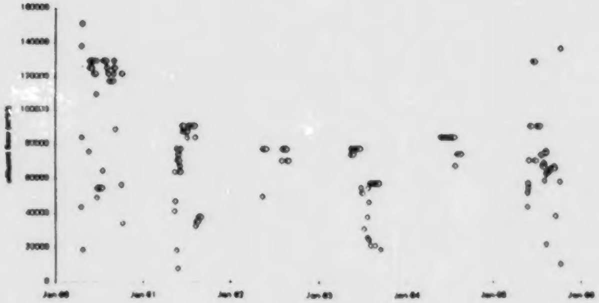
Performance Summary: Power Plants
Individual Daily Effluent Flow - Time Series
H.R. Milner Generating Station: 1990-1996



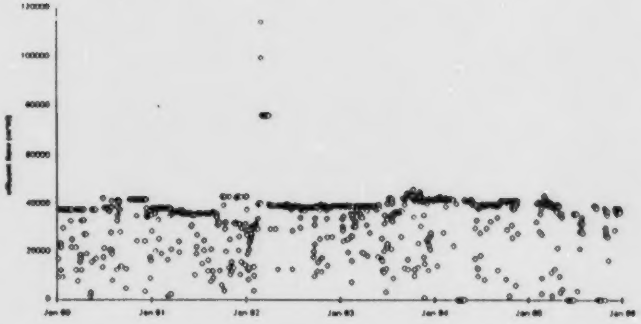
Performance Summary: Power Plants
Individual Daily Effluent Flow - Time Series
Keephills Generating Station: 1990-1996



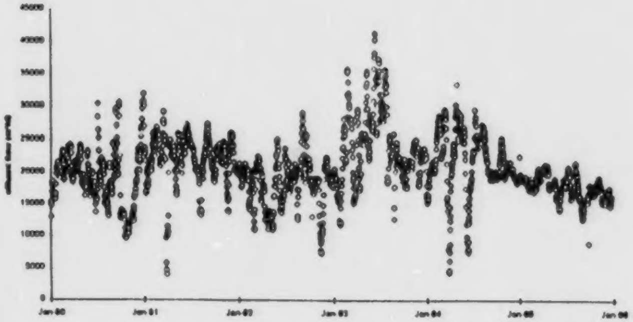
Performance Summary: Power Plants
Individual Daily Effluent Flow - Time Series
Sheerness Generating Station: 1990-1996



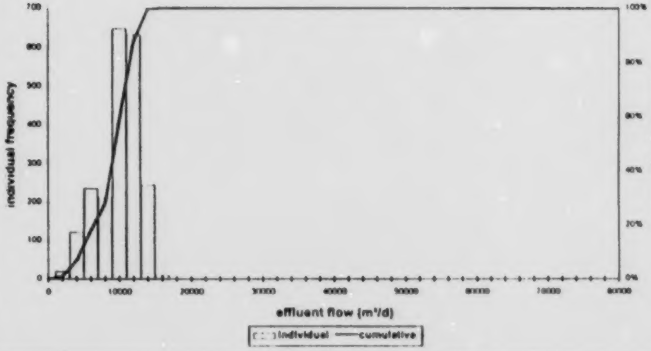
Performance Summary: Power Plants
Individual Daily Effluent Flow - Time Series
Sundance Generating Station: 1990-1996



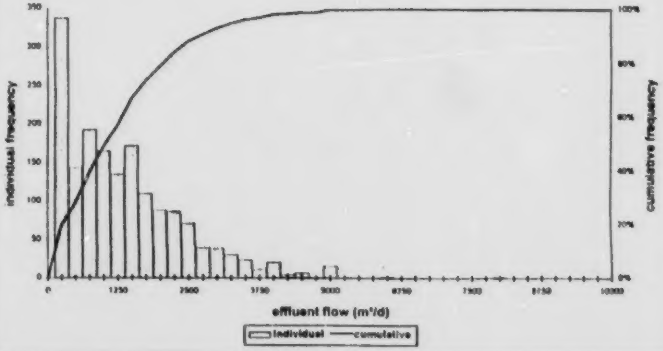
Performance Summary: Power Plants
Individual Daily Effluent Flow - Time Series
Wabamun Generating Station: 1990-1995



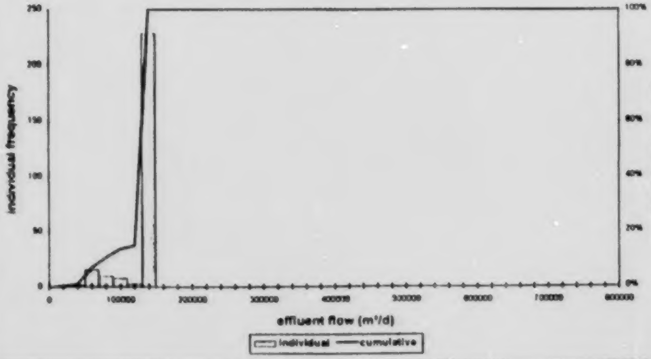
Performance Summary: Power Plants
Individual Daily Effluent Flow - Frequency Distribution
Battle River Generating Station: 1990-1995



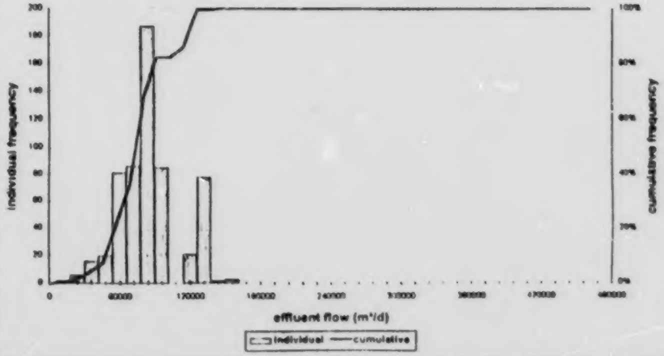
Performance Summary: Power Plants
Individual Daily Effluent Flow - Frequency Distribution
H.R. Milner Generating Station: 1990-1995



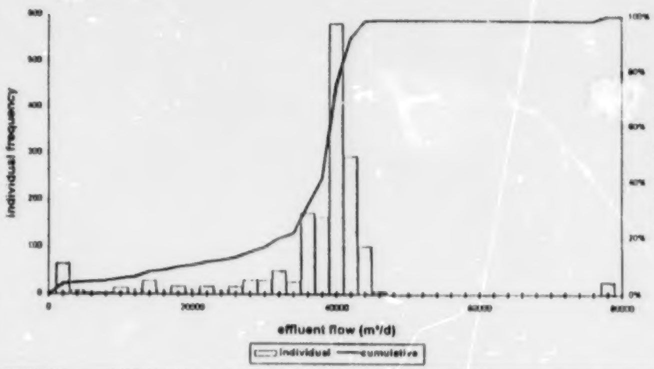
Performance Summary: Power Plants
Individual Daily Effluent Flow - Frequency Distribution
Keephills Generating Station: 1990-1995



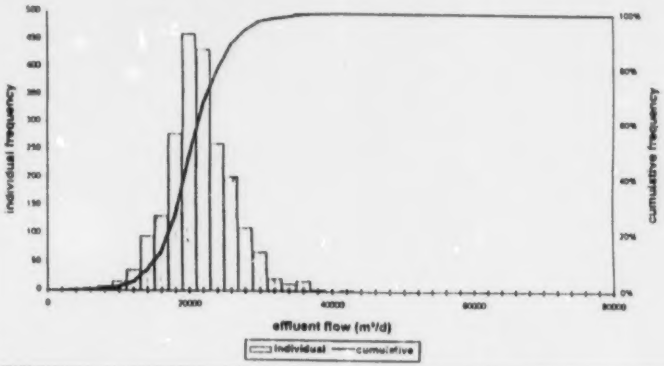
Performance Summary: Power Plants
Individual Daily Effluent Flow - Frequency Distribution
Sheerness Generating Station: 1990-1995



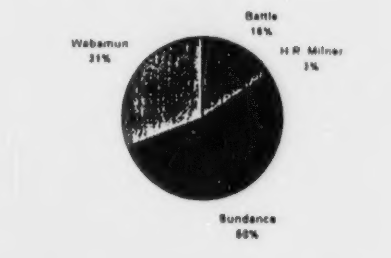
Performance Summary: Power Plants
Individual Daily Effluent Flow - Frequency Distribution
Sundance Generating Station: 1990-1995



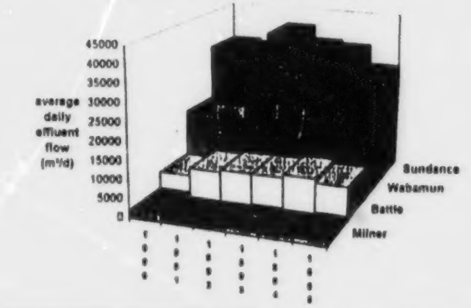
Performance Summary: Power Plants
Individual Daily Effluent Flow - Frequency Distribution
Wabamun Generating Station: 1990-1995



Performance Summary: Power Plants
Average Daily Effluent Flow for 1995
non-batch facilities only
100% = 58302.8 m³/d aggregate effluent flow



Performance Summary: Power Plants
Annually Averaged Daily Effluent Flow
non-batch facilities only ; 1990-1995



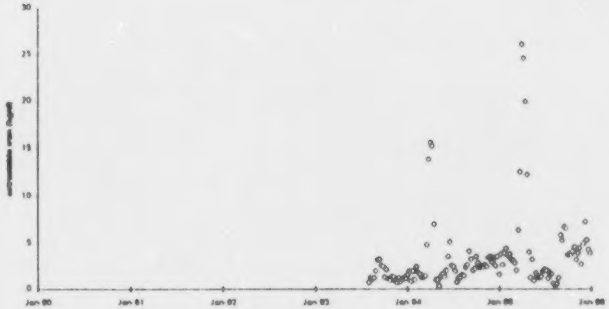
		calculation of aggregate (non-batch facilities only) (m³/d):						*aggregate (m³/d):*
		Battle	H.R. Milner	Keephills	Sheerness	Sundance	Wabamun	all
mode of operation:		continuous	continuous	batch	batch	continuous	continuous	[illegible]
total samples 1990-1995:		2139	1714	269	587	1734	2190	
average for:	1990	6681.6	2265.4			34627.7	19094.0	62668.7
	1991	8756.8	909.7			34004.7	22133.7	65804.9
	1992	9402.2	997.7			40030.9	18396.4	68827.2
	1993	9412.3	1365.0			36198.6	24147.9	71123.8
	1994	10229.7	1082.4			35332.8	21811.8	68456.7
	1995	9174.4	1480.7			29720.7	17926.9	58302.8
	1990-1995	8988.3	1264.1			35479.9	20586.3	66307.7

effluent flow: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

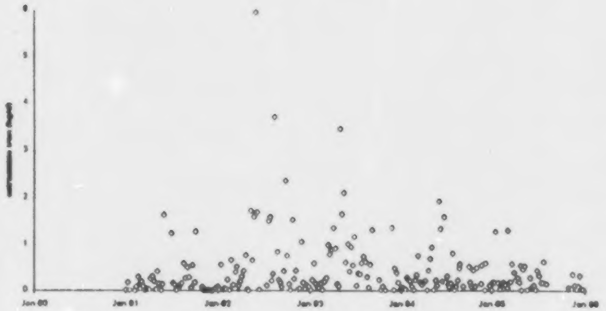
plant	1990 x (m³/d)	s (m³/d)	1991 x (m³/d)	s (m³/d)	1992 x (m³/d)	s (m³/d)	1993 x (m³/d)	s (m³/d)	1994 x (m³/d)	s (m³/d)	1995 x (m³/d)	s (m³/d)	1995 imposed limits (m³/d): daily	monthly
Battle	6681.6	2610.3	8756.8	2705.4	9402.2	2889.3	9412.3	2679.6	10229.7	2288.7	9174.4	2516.2	-	-
H.R. Milner	2265.4	1493.5	909.7	1281.7	997.7	987.1	1365.0	986.6	1082.4	849.3	1480.7	811.2	-	-
Keephills	-	-	120980.8	23144.6	122178.8	22348.0	117194.3	28855.6	114783.6	30009.3	124556.3	17239.0	-	-
Sheerness	106553.8	32157.8	71249.4	23402.2	75337.2	4577.1	63059.6	14486.1	80599.7	8390.4	78115.2	23161.6	-	-
Sundance	34627.7	9369.7	34004.7	7698.1	40030.9	14397.9	36198.6	8593.3	35332.8	13174.8	29720.7	16037.0	-	-
Wabamun	19094.0	4380.8	22133.7	3820.5	18396.4	3716.8	24147.9	5583.9	21811.8	4813.4	17926.9	1823.1	-	-

Iron

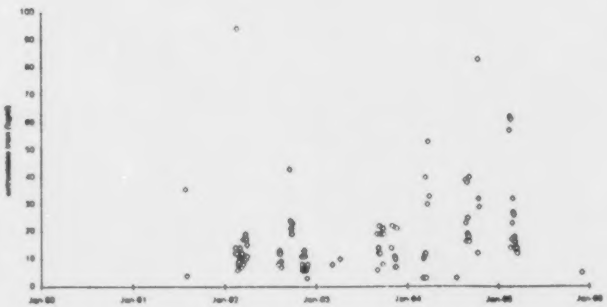
Performance Summary: Power Plants
Individual Daily Iron Loading - Time Series
Battle River Generating Station: 1990-1996



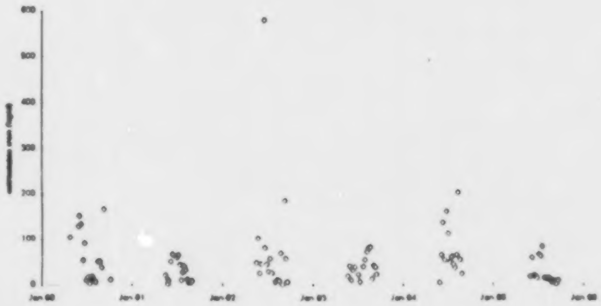
Performance Summary: Power Plants
Individual Daily Iron Loading - Time Series
H.R. Milner Generating Station: 1990-1996



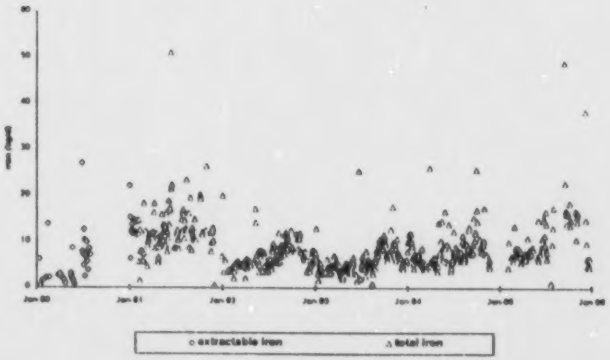
Performance Summary: Power Plants
Individual Daily Iron Loading - Time Series
Keephills generating Station: 1990-1996



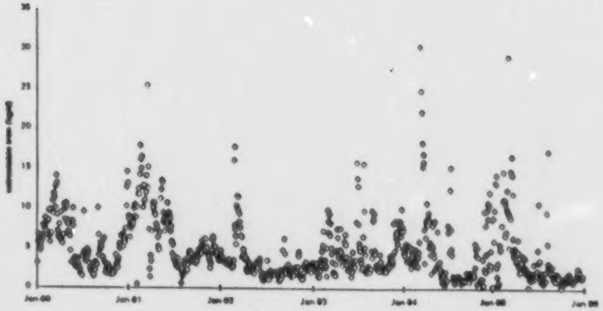
Performance Summary: Power Plants
Individual Daily Iron Loading - Time Series
Sheerness Generating Station: 1990-1996



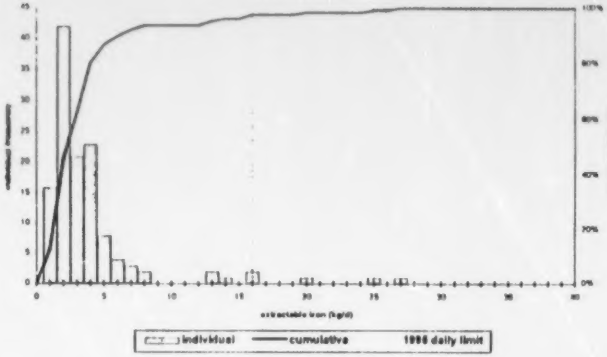
Performance Summary: Power Plants
Individual Daily Iron Loading - Time Series
Sundance Generating Station: 1990-1996



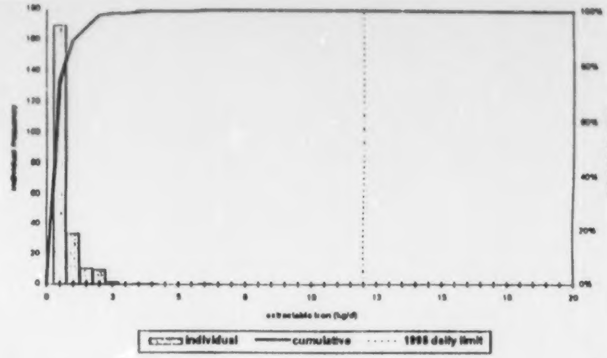
Performance Summary: Power Plants
Individual Daily Iron Loading - Time Series
Wabamun Generating Station: 1990-1996



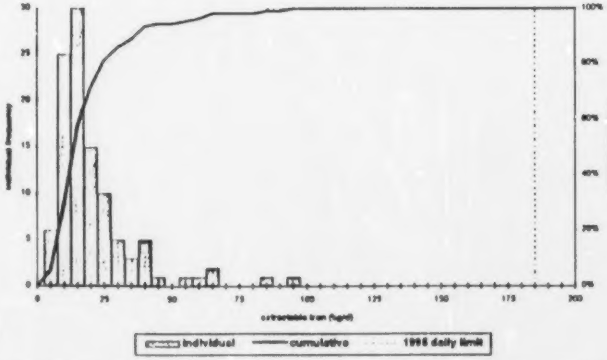
Performance Summary: Power Plants
Individual Daily Iron Loading - Frequency Distribution
Battle River Generating Station: 1990-1995



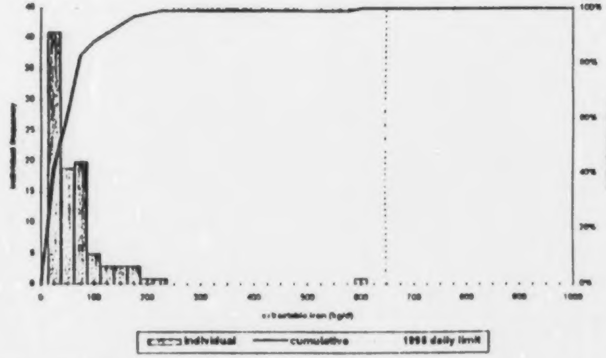
Performance Summary: Power Plants
Individual Daily Iron Loading - Frequency Distribution
H.R. Milner Generating Station: 1990-1995

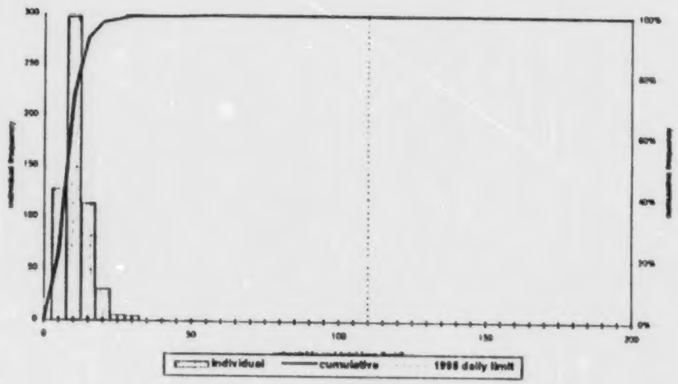


Performance Summary: Power Plants
Individual Daily Iron Loading - Frequency Distribution
Keephills Generating Station: 1990-1995

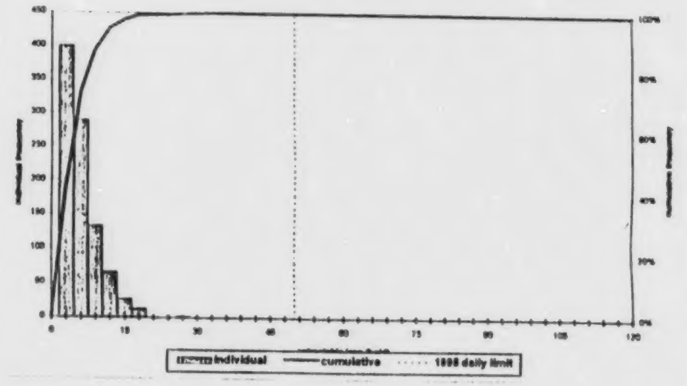


Performance Summary: Power Plants
Individual Daily Iron Loading - Frequency Distribution
Sheerness Generating Station: 1990-1995





Performance Summary: Power Plants
Individual Daily Iron Loading - Frequency Distribution
Sundance Generating Station: 1990-1996



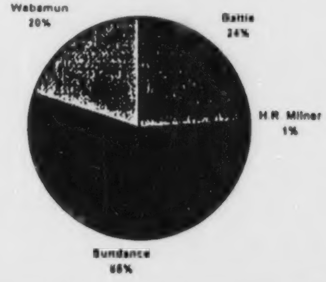
Performance Summary: Power Plants
Individual Daily Iron Loading - Frequency Distribution
Wabamun Generating Station: 1990-1996

Performance Summary: Power Plants

Average Daily Iron Loading for 1995

non-batch facilities only

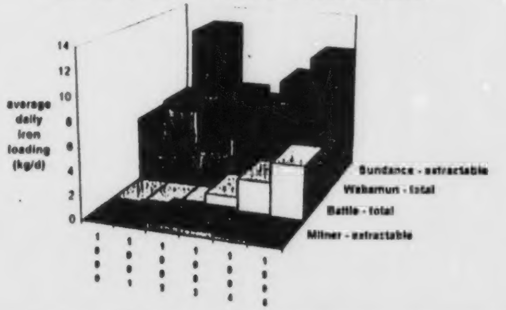
100% = 19.7 kg/d iron (total or extractable)



Performance Summary: Power Plants

Annually Averaged Daily Iron Loading

non-batch facilities only ; 1990-1995 ; total or extractable



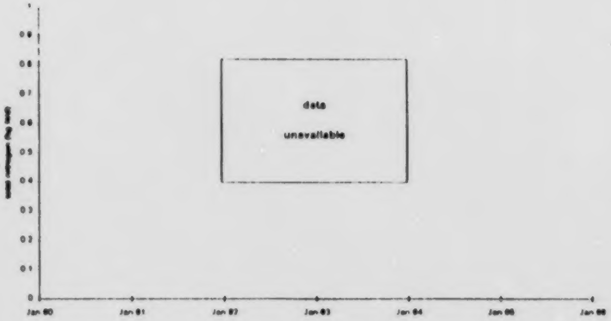
		calculation of aggregate (non-batch facilities only) (kg/d):						aggregate (kg/d):
		Battle	H.R. Milner	Keephills	Sheerness	Sundance	Wabamun	all
mode of operation:		continuous	continuous	batch	batch	continuous	continuous	
total samples 1990-1995:		127	230	106	97	585	940	
average for:	1990	-	-			5.75	5.45	11.20
	1991	-	0.22			12.50	6.70	19.42
	1992	-	0.65			6.70	3.26	10.61
	1993	1.45	0.58			5.98	4.58	12.59
	1994	3.02	0.35			8.50	4.55	16.42
	1995	4.70	0.26			10.81	3.94	19.71
	1990-1995	3.46	0.42			8.42	4.74	17.04

iron: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Battle	-	-	-	-	-	-	1.45	0.76	3.02	3.22	4.70	6.32	16	8
H.R. Milner	-	-	0.22	0.35	0.65	1.08	0.58	0.68	0.35	0.41	0.26	0.29	12	6
Keephills	-	-	19.77	22.44	14.11	13.91	13.79	6.89	25.76	18.17	25.69	18.27	186	93
Sheerness	61.82	56.28	28.69	23.15	81.29	136.15	38.50	23.69	76.64	65.84	25.24	26.03	566	283
Sundance	5.75	5.38	12.50	5.79	6.70	2.82	5.98	3.12	8.50	3.70	10.81	7.00	110	55
Wabamun	5.45	3.01	6.70	4.00	3.26	2.48	4.58	2.74	4.55	4.87	3.94	4.36	50	25

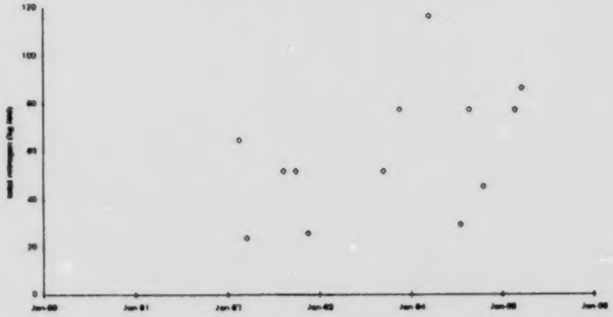
Nitrogen

Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Time Series
Battle River Generating Station: 1990-1995

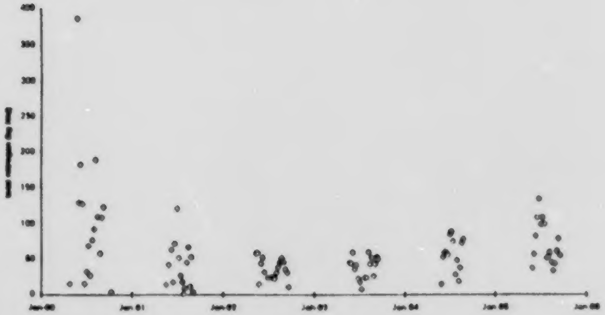


Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Time Series
H.R. Milner Generating Station: 1990-1995

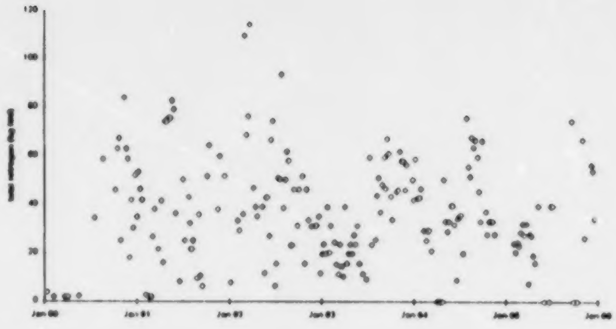
Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Time Series
Keephills Generating Station: 1990-1995



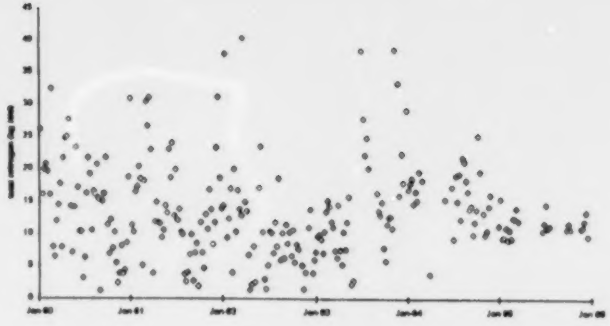
Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Time Series
Sheerness Generating Station: 1990-1995



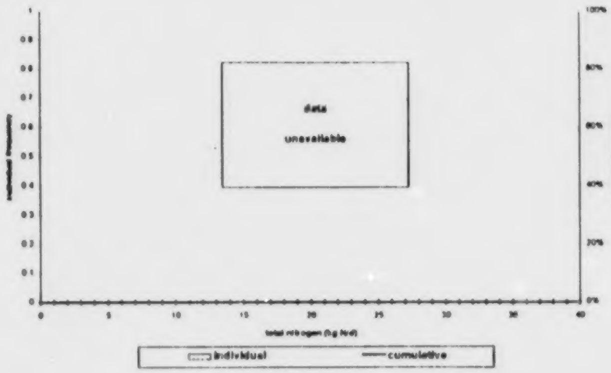
Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Time Series
Sundance Generating Station: 1990-1996



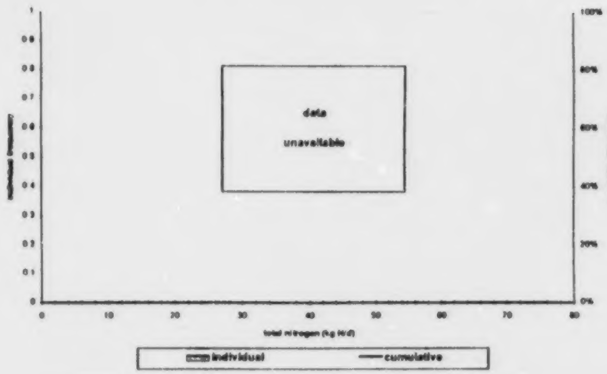
Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Time Series
Wabamun Generating Station: 1990-1996



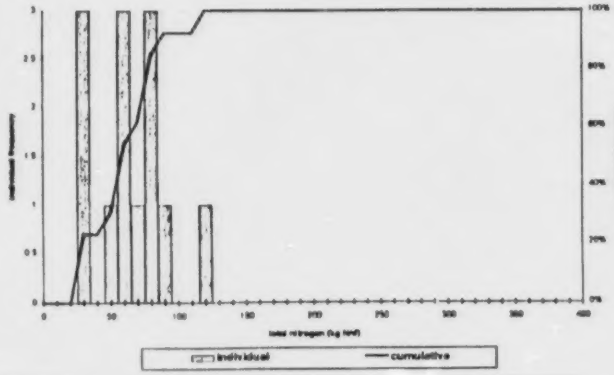
Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Frequency Distribution
Battle River Generating Station: 1990-1995



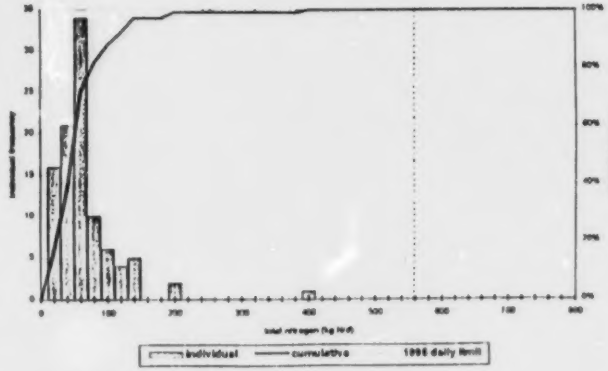
Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Frequency Distribution
H.R. Milner Generating Station: 1990-1995



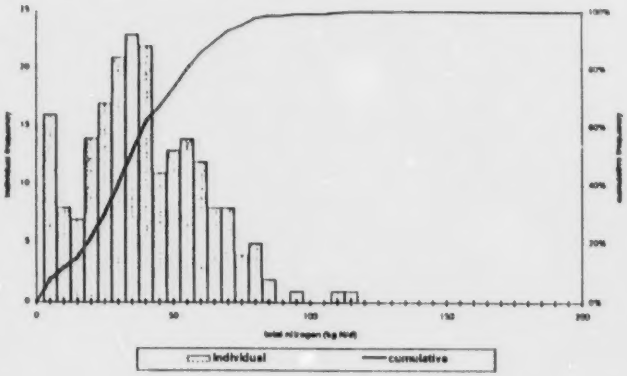
Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Frequency Distribution
Keephills Generating Station: 1990-1995



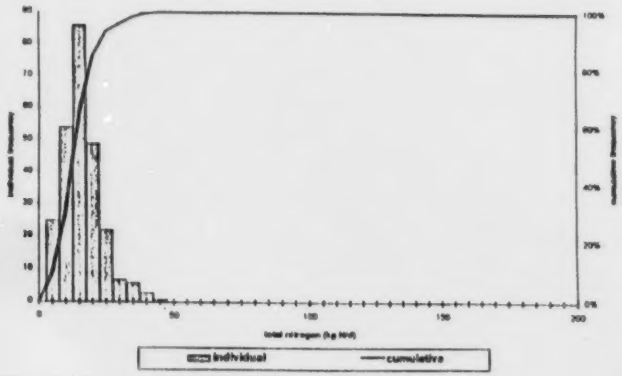
Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Frequency Distribution
Sheerness Generating Station: 1990-1995



Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Frequency Distribution
Sundance Generating Station: 1990-1995



Performance Summary: Power Plants
Individual Daily Nitrogen Loading - Frequency Distribution
Wabamun Generating Station: 1990-1995

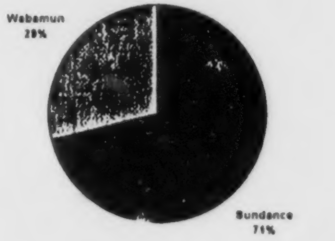


Performance Summary: Power Plants

Average Daily Nitrogen Loading for 1995

non-batch facilities only

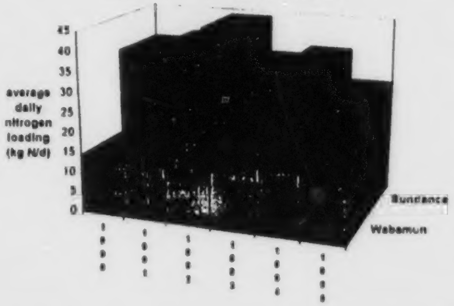
100% = 40.1 kg N/d aggregate total nitrogen loading



Performance Summary: Power Plants

Annually Averaged Daily Total Nitrogen Loading

non-batch facilities only ; 1990-1995



[illegible]	calculation of aggregate (non-batch facilities only) (kg N/d): Battie	H.R. Milner	Keephills	Sheerness	Sundance	Wabamun	aggregate (kg/d): all
mode of operation:	continuous	continuous	batch	batch	continuous	continuous	[illegible]
total samples 1990-1995:	0	0	13	99	208	253	
average for: 1990	-	-			36.4	14.5	50.9
1991	-	-			38.4	13.7	52.1
1992	-	-			43.6	10.8	54.4
1993	-	-			34.4	14.2	48.5
1994	-	-			36.4	16.1	52.5
1995	-	-			28.6	11.5	40.1
1990-1995	-	-			36.8	13.6	50.2

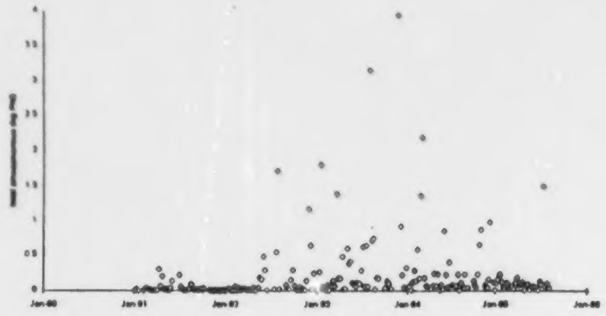
total nitrogen: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

plant	1990 x (kg N/d)	s (kg N/d)	1991 x (kg N/d)	s (kg N/d)	1992 x (kg N/d)	s (kg N/d)	1993 x (kg N/d)	s (kg N/d)	1994 x (kg N/d)	s (kg N/d)	1995 x (kg N/d)	s (kg N/d)	1995 imposed limits (kg N/d): daily	monthly
Battie	-	-	-	-	-	-	-	-	-	-	-	-	none	none
H.R. Milner	-	-	-	-	-	-	-	-	-	-	-	-	none	none
Keephills	-	-	-	-	43.6	18.0	64.8	18.3	67.4	38.5	82.4	6.5	none	none
Sheerness	103.2	92.0	38.9	32.5	36.1	14.5	38.3	16.3	55.2	23.7	71.1	29.9	658	275
Sundance	36.4	26.9	38.4	24.1	43.6	24.8	34.4	17.1	36.4	18.5	28.6	19.5	none	none
Wabamun	14.5	7.6	13.7	7.4	10.8	7.9	14.2	8.5	16.1	4.8	11.5	1.7	none	none

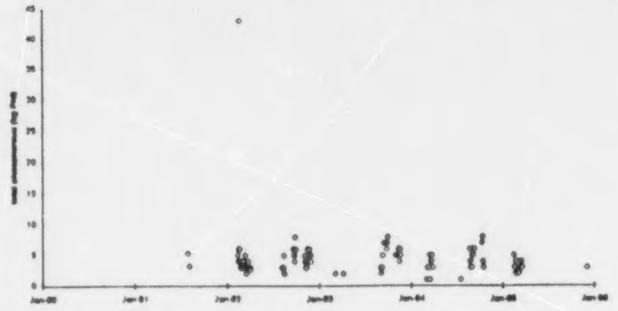
Phosphorous

Performance Summary: Power Plants
Individual Daily Phosphorous Loading - Time Series
Battle River Generating Station: 1990-1995

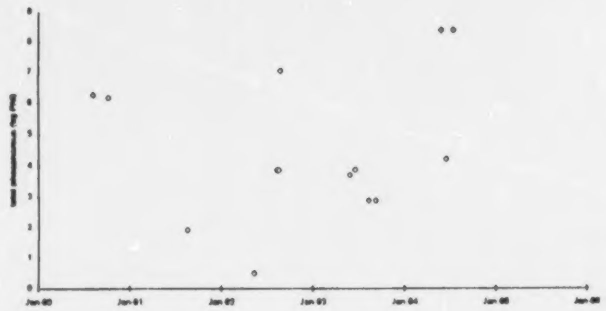
Performance Summary: Power Plants
Individual Daily Phosphorous Loading - Time Series
H.R. Milner Generating Station: 1990-1995



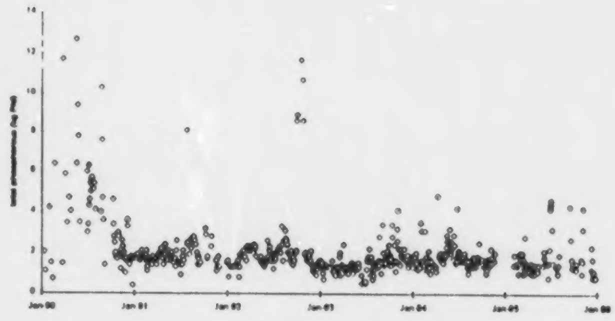
Performance Summary: Power Plants
Individual Daily Phosphorous Loading - Time Series
Keephills Generating Station: 1990-1995



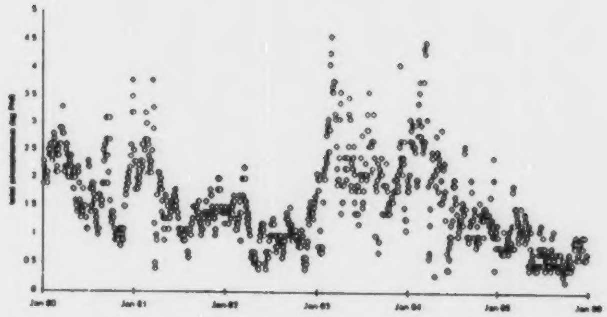
Performance Summary: Power Plants
Individual Daily Phosphorous Loading - Time Series
Sheerness Generating Station: 1990-1995



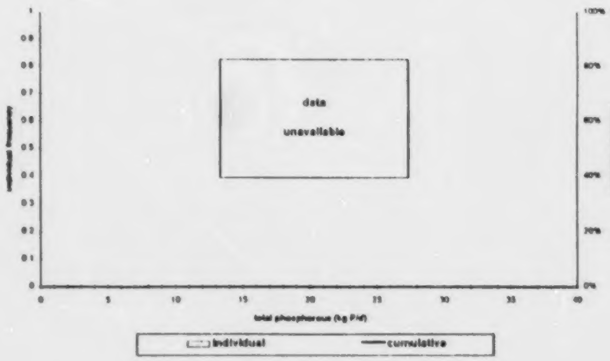
Performance Summary: Power Plants
Individual Daily Phosphorous Loading - Time Series
Sundance Generating Station: 1990-1996



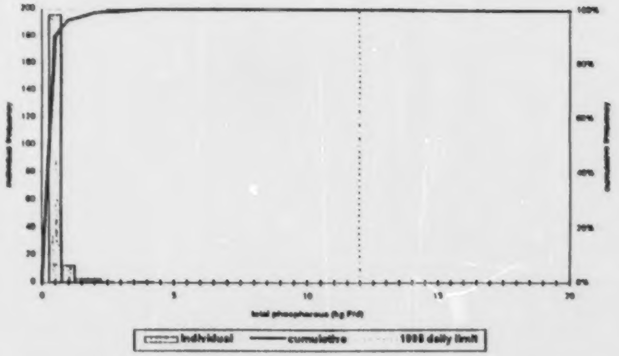
Performance Summary: Power Plants
Individual Daily Phosphorous Loading - Time Series
Wabamun Generating Station: 1990-1996



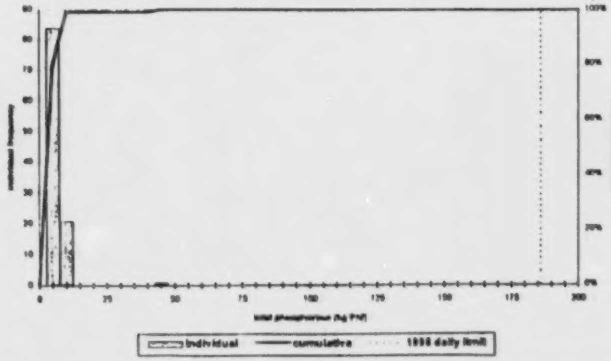
Performance Summary: Power Plants
Individual Daily Phosphorous Loading - Frequency Distribution
Battle River Generating Station: 1990-1996



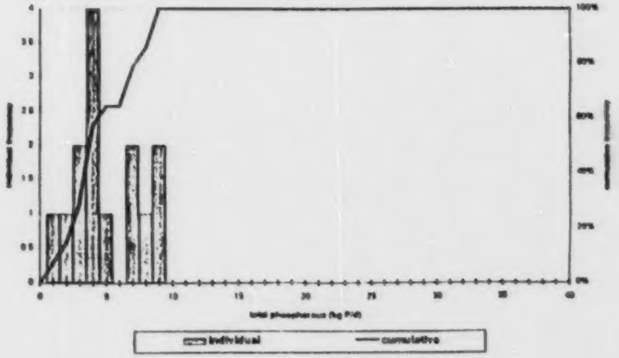
Performance Summary: Power Plants
Individual Daily Phosphorous Loading - Frequency Distribution
H.R. Milner Generating Station: 1990-1996



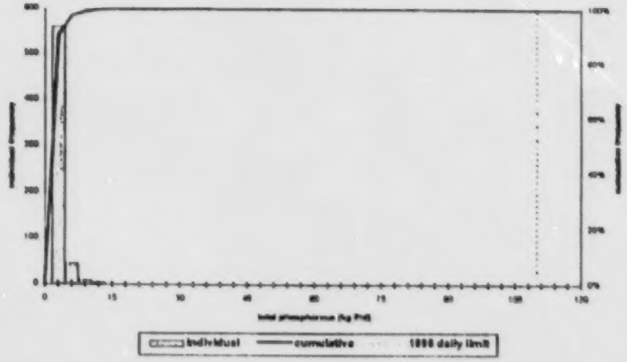
Performance Summary: Power Plants
Individual Daily Phosphorous Loading - Frequency Distribution
Keephills Generating Station: 1990-1996



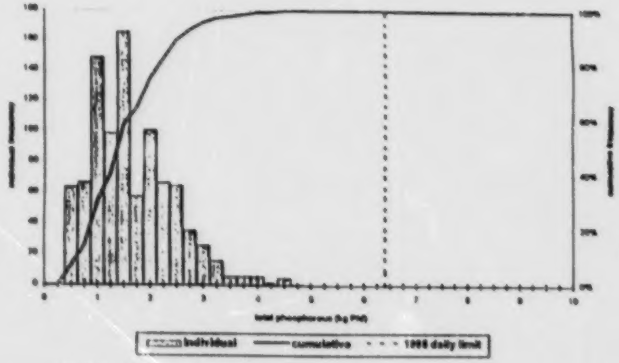
Performance Summary: Power Plants
Individual Daily Phosphorous Loading - Frequency Distribution
Sheerness Generating Station: 1990-1996



Performance Summary: Power Plants
Individual Daily Phosphorous Loading - Frequency Distribution
Sundance Generating Station: 1990-1996



Performance Summary: Power Plants
Iindividual Daily Phosphorous Loading - Frequency Distribution
Wabamun Generating Station: 1990-1996

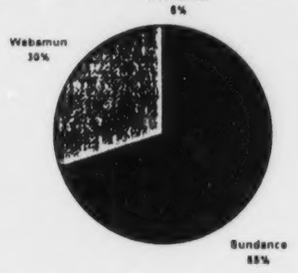


Performance Summary: Power Plants

Average Daily Phosphorous Loading for 1995

non-batch facilities only

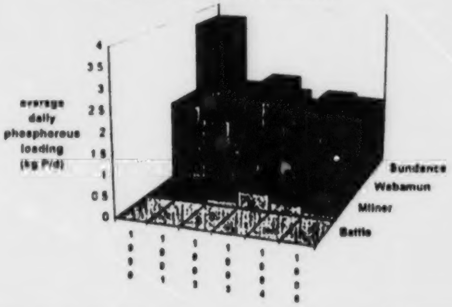
100% = 2.6 kg P/d aggregate total phosphorous loading



Performance Summary: Power Plants

Annually Averaged Daily Total Phosphorous Loading

non-batch facilities only ; 1990-1995



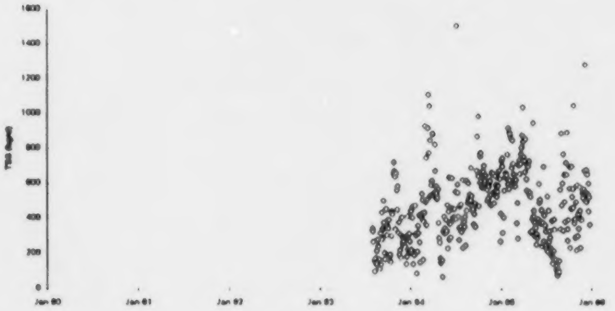
		calculation of aggregate (non-batch facilities only) (kg P/d):						aggregate (kg P/d):
		Battle	H.R. Milner	Keephills	Sheerness	Sundance	Wabamun	all
mode of operation:		continuous	continuous	batch	batch	continuous	continuous	
total samples 1990-1995:		0	218	106	14	622	941	
average for:	1990	-	-			3.7	1.9	5.6
	1991	-	0.0			1.9	1.6	3.5
	1992	-	0.1			2.1	1.1	3.3
	1993	-	0.4			1.5	2.2	4.1
	1994	-	0.2			1.8	1.8	3.8
	1995	-	0.1			1.7	0.8	2.6
	1990-1995	-	0.2			2.0	1.6	3.8

total phosphorous: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

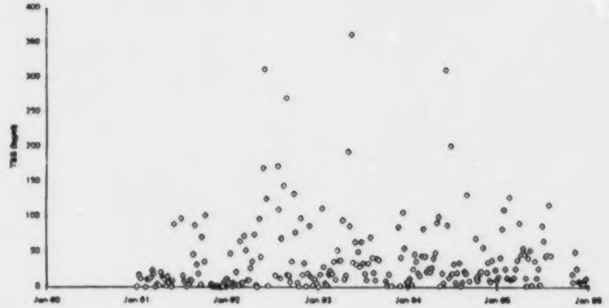
	1990		1991		1992		1993		1994		1995		1996 imposed limits (kg P/d):	
plant	x (kg P/d)	s (kg P/d)	x (kg P/d)	s (kg P/d)	x (kg P/d)	s (kg P/d)	x (kg P/d)	s (kg P/d)	x (kg P/d)	s (kg P/d)	x (kg P/d)	s (kg P/d)	daily	monthly
Battle	-	-	-	-	-	-	-	-	-	-	-	-	none	none
H.R. Milner	-	-	0.0	0.1	0.1	0.3	0.4	0.8	0.2	0.4	0.1	0.3	12	6
Keephills	-	-	4.3	1.6	6.0	6.9	4.9	1.8	4.0	1.6	2.9	0.9	186	95
Sheerness	6.2	0.1	1.9	-	3.8	2.7	3.3	0.5	7.0	2.4	-	-	none	none
Sundance	3.7	2.6	1.9	0.7	2.1	1.6	1.5	0.6	1.8	0.6	1.7	0.9	110	56
Wabamun	1.9	0.6	1.6	0.6	1.1	0.4	2.2	0.7	1.8	0.9	0.8	0.3	6.4	3.2

Total Suspended Solids
(TSS)

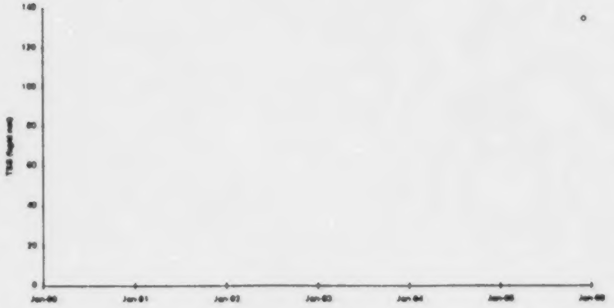
Performance Summary: Power Plants
Individual Daily TSS Loading - Time Series
Battle River Generating Station: 1990-1995



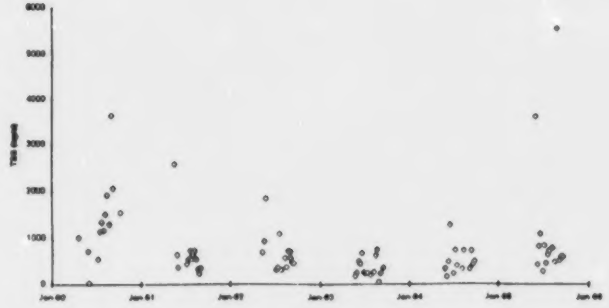
Performance Summary: Power Plants
Individual Daily TSS Loading - Time Series
H.R. Milner Generating Station: 1990-1995



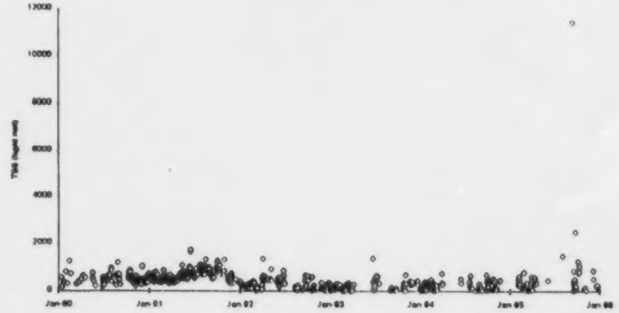
Performance Summary: Power Plants
Individual Daily TSS Loading - Time Series
Keephills Generating Station: 1990-1995



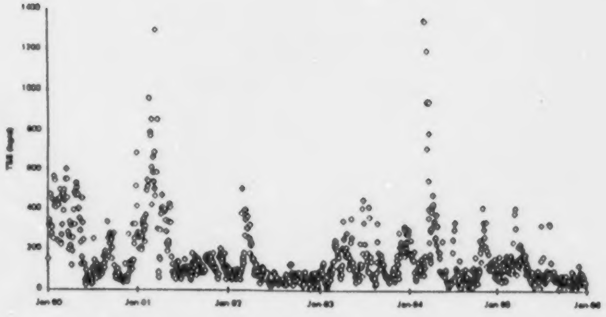
Performance Summary: Power Plants
Individual Daily TSS Loading - Time Series
Sheerness Generating Station: 1990-1995



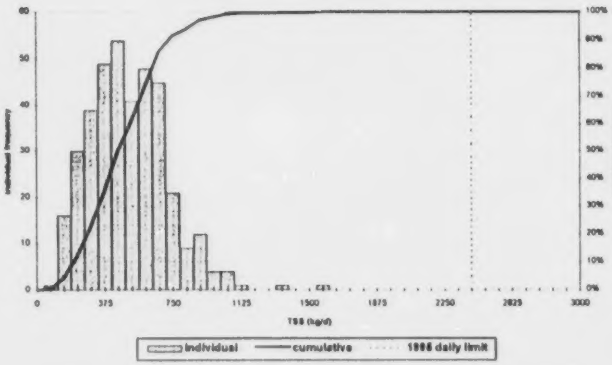
Performance Summary: Power Plants
Individual Daily TSS Loading - Time Series
Sundance Generating Station: 1990-1996



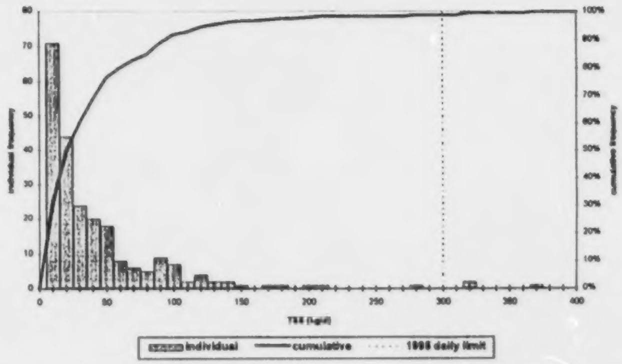
Performance Summary: Power Plants
Individual Daily TSS Loading - Time Series
Wabamun Generating Station: 1990-1996



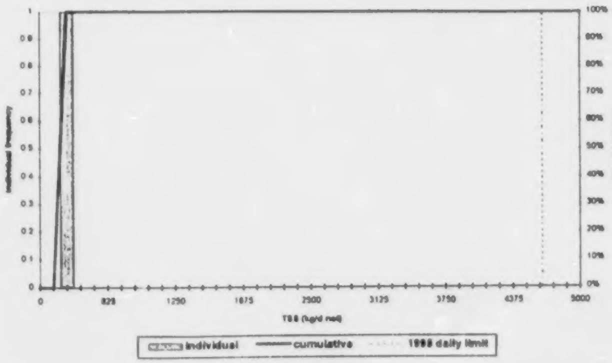
Performance Summary: Power Plants
Individual Daily TSS Loading - Frequency Distribution
Battle River Generating Station: 1990-1995



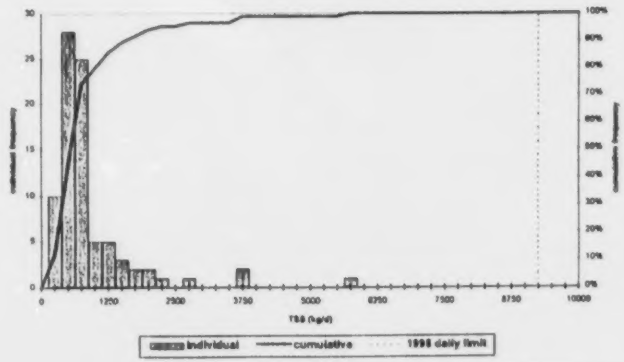
Performance Summary: Power Plants
Individual Daily TSS Loading - Frequency Distribution
H.R. Milner Generating Station: 1990-1995



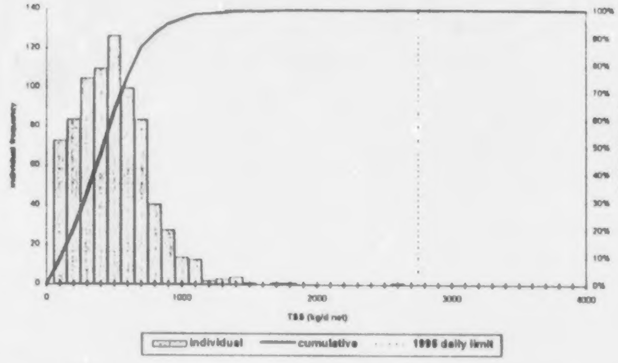
Performance Summary: Power Plants
Individual Daily TSS Loading - Frequency Distribution
Keephills Generating Station: 1990-1995



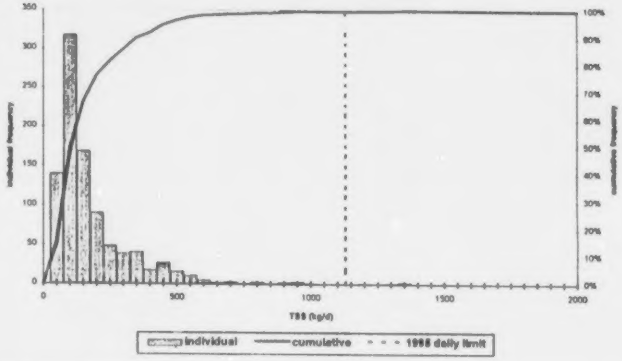
Performance Summary: Power Plants
Individual Daily TSS Loading - Frequency Distribution
Sheerness Generating Station: 1990-1995



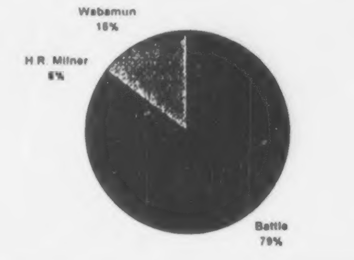
Performance Summary: Power Plants
Individual Daily TSS Loading - Frequency Distribution
Sundance Generating Station: 1990-1995



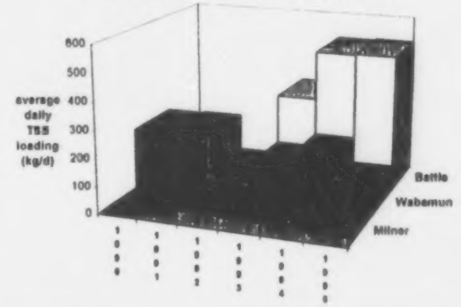
Performance Summary: Power Plants
Iindividual Daily TSS Loading - Frequency Distribution
Wabamun Generating Station: 1990-1995



Performance Summary: Power Plants
Average Daily TSS Loading for 1995
non-batch & non-net facilities only
100% = 633.2 kg/d aggregate total TSS loading



Performance Summary: Power Plants
Annually Averaged Daily TSS
non-batch & non-net facilities only ; 1990-1995



		calculation of aggregate (non-batch and non-net facilities only) (kg/d):						*aggregate (kg/d):*
		Battle	H.R. Milner	Keephills	Sheerness	Sundance	Wabamun	all
mode of operation:		continuous	continuous	batch	batch	continuous	continuous	
total samples 1990-1995:		376	231	1	85	793	943	
average for:	1990	-	-				224.2	224.2
	1991	-	18.7				229.5	248.1
	1992	-	51.8				89.3	141.1
	1993	318.3	45.5				139.7	503.5
	1994	499.0	40.7				186.1	725.8
	1995	502.8	36.6				93.8	633.2
	1990-1995	469.3	39.0				160.5	668.8

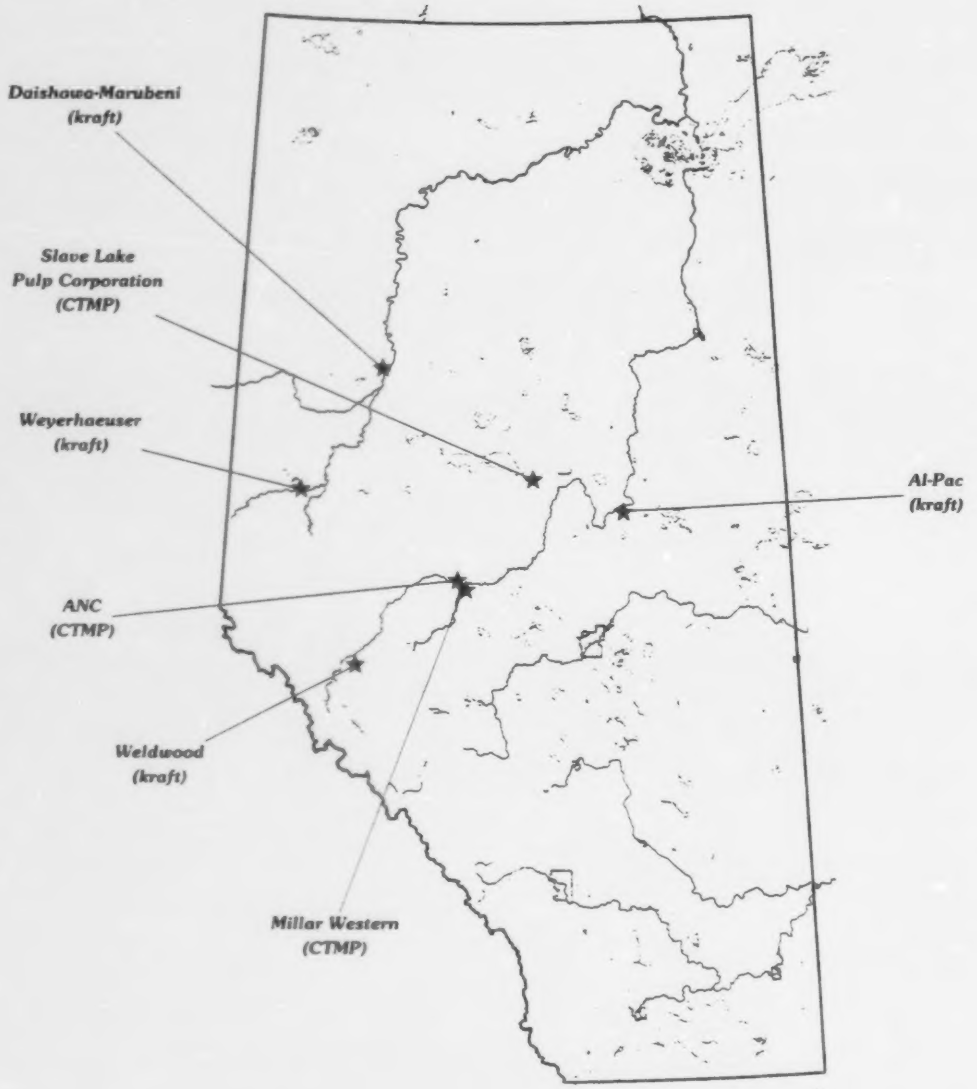
note:

Sundance reports NET values

TSS loading: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1996 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Battle	-	-	-	-	-	-	318.3	146.9	499.0	206.5	502.8	221.4	2400	1050
H.R. Milner	-	-	18.7	27.4	51.8	88.4	45.5	60.4	40.7	54.2	36.6	33.3	300	150
Keephills	-	-	-	-	-	-	-	-	-	-	135.0	-	4650 (net)	2325 (net)
Sheerness	1379.5	870.1	640.3	578.8	670.9	408.2	365.5	203.2	497.9	288.0	1161.9	1456.0	9245	3750
Sundance	603.1	187.0	632.9	223.7	327.5	203.4	231.2	195.8	241.7	156.6	604.7	1475.5	2750 (net)	1430 (net)
Wabamun	224.2	160.0	229.5	203.9	89.3	81.4	139.7	87.8	186.1	227.2	93.8	89.3	1130	575

Pulp & Paper Mills


Daishowa-Marubeni (kraft)
Slave Lake Pulp Corporation (CTMP)
Weyerhaeuser (kraft)
Al-Pac (kraft)
ANC (CTMP)
Weldwood (kraft)
Millar Western (CTMP)

Pulp & Paper Mills

General

This sector has become large and varied, comprising plants of different design, technical sophistication, production capacity and geographic location. There are currently seven pulp & paper mills operating in Alberta, and all practice direct discharge. All seven mills are located in the north-central and northern parts of the province: four are located directly upon the Athabasca River, and a fifth is just upstream of it on one of its tributaries; the remaining two are located farther to the north, in the Peace River basin.

Although there is a great variety in the actual chemical agents and physical processes employed at each pulp & paper mill, all may be subdivided into one of two general categories. Four of the mills employ a bleached kraft process (BKP), where pulp is produced by a primarily chemical process which relies heavily upon chemical agents to decompose the raw wood starting materials into pulp. The remainder employ a chemithermomechanical process (CTMP), a process characterized by physical and thermal exertions upon the raw wood, with much less reliance upon chemicals. Depending upon the plant, softwoods, hardwoods or both can be processed into pulp. While all seven mills do produce pulp, only one of them further refines the pulp into a finished product, newsprint; the remainder ship the raw pulp elsewhere for finishing.

Facilities

Weldwood of Canada operates a bleached kraft plant with a capacity[*] of 1100 air-dried metric tons per day (ADMTD) on the Athabasca River at Hinton. Weldwood uses extended delignification cooking and oxygen delignification. In 1994, Weldwood discontinued the use of chlorine gas and began to apply 100% chlorine dioxide as a bleaching agent, a move which resulted in a significant reduction in the levels of effluent AOX (adsorbable organic halogens) and colour[**]. Weldwood is the farthest upstream of all the mills along the Athabasca River, and it is the oldest pulp mill in Alberta, having started operations in 1957.

Farther downstream, two mills are located near the town of Whitecourt. Alberta Newsprint Company (ANC) operates a 700 ADMTD CTMP newsprint[***] mill just upstream of the confluence of the Athabasca and McLeod Rivers. This mill was opened in 1990 and also contains a pilot-scale de-inking facility which allows up to 10% recycled newsprint to be included in the final product. Just downstream, Millar Western operates a 680 ADMTD CTMP pulp mill which began operations in 1988. Wastewater effluent is passed through an on-site activated sludge plant for treatment before being released into the Athabasca River.

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[*] These numbers represents the design capacity, not the actual production levels.

[**] This is clearly illustrated (for example) by Weldwood's or Weyerhaeuser's time series (*seq. inf.*).

[***] This is the only *newsprint* mill (as opposed to *pulp* mill) in Alberta.

Slave Lake Pulp Corporation opened a 350 ADMTD CTMP facility on the Lesser Slave River near Smith in late 1990.

The final facility on the Athabasca River is Alberta-Pacific (Al-Pac) Forest Industries' BKP pulp mill near Athabasca. Al-Pac is the newest pulp mill in Alberta, having opened in 1993, and is the largest based upon design capacity. Given its status as the farthest downstream of five mills on the Athabasca River, and given its large size, Al-Pac has been assigned more stringent effluent limits. Al-Pac employs extended delignification cooking and oxygen delignification, and it also operates with 100% chlorine dioxide as a bleaching agent.

Weyerhaeuser Canada Limited operates a bleached kraft pulp mill along the Wapiti River near Grande Prairie. This mill was originally opened by Procter & Gamble in 1973. In order to meet more stringent approval requirements expected in the future, Weyerhaeuser has been installing many improvements to their in-plant pulping process and effluent treatment system.

Finally, Daishowa-Marubeni Canada has operated a 1000 ADMTD bleached kraft pulp mill along the Peace River since 1990. Both extended delignification cooking and oxygen delignification are employed at this mill. Its effluent is treated in a conventional aerated lagoon before release to the Peace River.

The seven pulp & paper mills are summarized in the following table:

Pulp and Paper Mills General Information

mill	river	location	basin	process	opened
Weldwood	Athabasca	Hinton	Athabasca	BKP	1958
ANC	Athabasca	Whitecourt	Athabasca	CTMP	1990
Millar Western	Athabasca	Whitecourt	Athabasca	CTMP	1988
Slave Lake	Lesser Slave	Smith	Athabasca	CTMP	1990
Al-Pac	Athabasca	Athabasca	Athabasca	BKP	1993
Weyerhaeuser	Wapiti	Grande Prairie	Peace	BKP	1973
Daishowa	Peace	Peace River	Peace	BKP	1990

Monitoring

There are thirty-seven separate discharge monitoring requirements for this sector. Of these, six of the most general parameters (AOX, BOD, COD[*], TSS, colour & flow[**]) were subjected to a rather extensive analysis and presentation along with production, a parameter which is not limited but which is nonetheless a common and useful descriptor for this particular sector. Any imposed effluent limits for these parameters are summarised in the following table:

Pulp and Paper Mills Mandated Effluent Limits

mill	parameter	1995 daily limit (kg/d)	1995 monthly limit (kg/d)
Weldwood	AOX	3300	1650
	BOD	6600	3300
	COD	not applicable	not applicable
	colour	200000	154000
	TSS	19140	9570
ANC	AOX	not applicable[***]	not applicable
	BOD	4200	2100
	COD	not applicable	not applicable
	colour	42000	31500
	TSS	7000	3500
Millar Western	AOX	not applicable	not applicable
	BOD	4080	2040
	COD	not applicable	not applicable
	colour	40800	30600
	TSS	6800	3400
Slave Lake	AOX	not applicable	not applicable
	BOD	2100	1050
	COD	not applicable	not applicable
	colour	24000	18000

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[*] Chemical oxygen demand (COD) is not currently limited and has not been limited up to this point. Future approvals will, however, specify limits upon COD.

[**] Although flow is a *regulated* monitoring requirement, it is not a *limited* monitoring requirement.

[***] As CTMP plants do not employ halogenated bleaching agents, there is virtually no production of AOX.

mill	parameter	1995 daily limit (kg/d)	1995 monthly limit (kg/d)
	TSS	4000	2000
Al-Pac	AOX	1390	818
	BOD	2250	1125
	COD	not applicable	not applicable
	colour	185500	10400
	TSS	9000	4500
Weyerhaeuser	AOX	2460	1230
	BOD	2460	1230
	COD	not applicable	not applicable
	colour	209700	114800
	TSS	8200	4100
Daishowa	AOX	2800	1400
	BOD	5500	2750
	COD	not applicable	not applicable
	colour	224000	182000
	TSS	18000	9500
AGGREGATE***	***AOX***	***9950***	***5098***
	BOD	***37400***	***18700***
	COLOUR	***634900***	***925400***
	TSS	***72140***	***36570***

AEP's Industrial Wastewater Branch also holds monitoring data for numerous other substances including trace organics and biological nutrients. Typically, these substances are monitored less frequently than general parameters such as BOD and TSS, and they may or may not be limited depending upon both the substance and the particular plant**. Collected effluent monitoring data for these substances are presented collectively in three subsections entitled *nutrients*, *trace organics*, and *others* at the end of this chapter. The substances included therein are summarised in the following table:

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* Aggregate daily and aggregate monthly limits are simply the sum of the seven individual daily limits and seven individual monthly limits respectively.

** For more information, consult the *Summary of Alberta Standards & Monitoring Requirements*, July 1995.

Pulp and Paper Mills Additional Parameters

subsection	contaminants addressed
trace organics	dehydroabietic acid (DHA)
	2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)
	total tetrachlorodibenzo-p-dioxin (total TCDD)
	2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDF)
	total tetrachlorodibenzo-p-dioxin (total TCDF)
	2,4 dichlorophenol (2,4 DCP)
	total chlorinated phenols
nutrients	ammonia (as N)
	nitrate (as N)
	nitrite (as N)
	total Kjeldahl nitrogen (TKN)
	total phosphorous
others	total sulphate

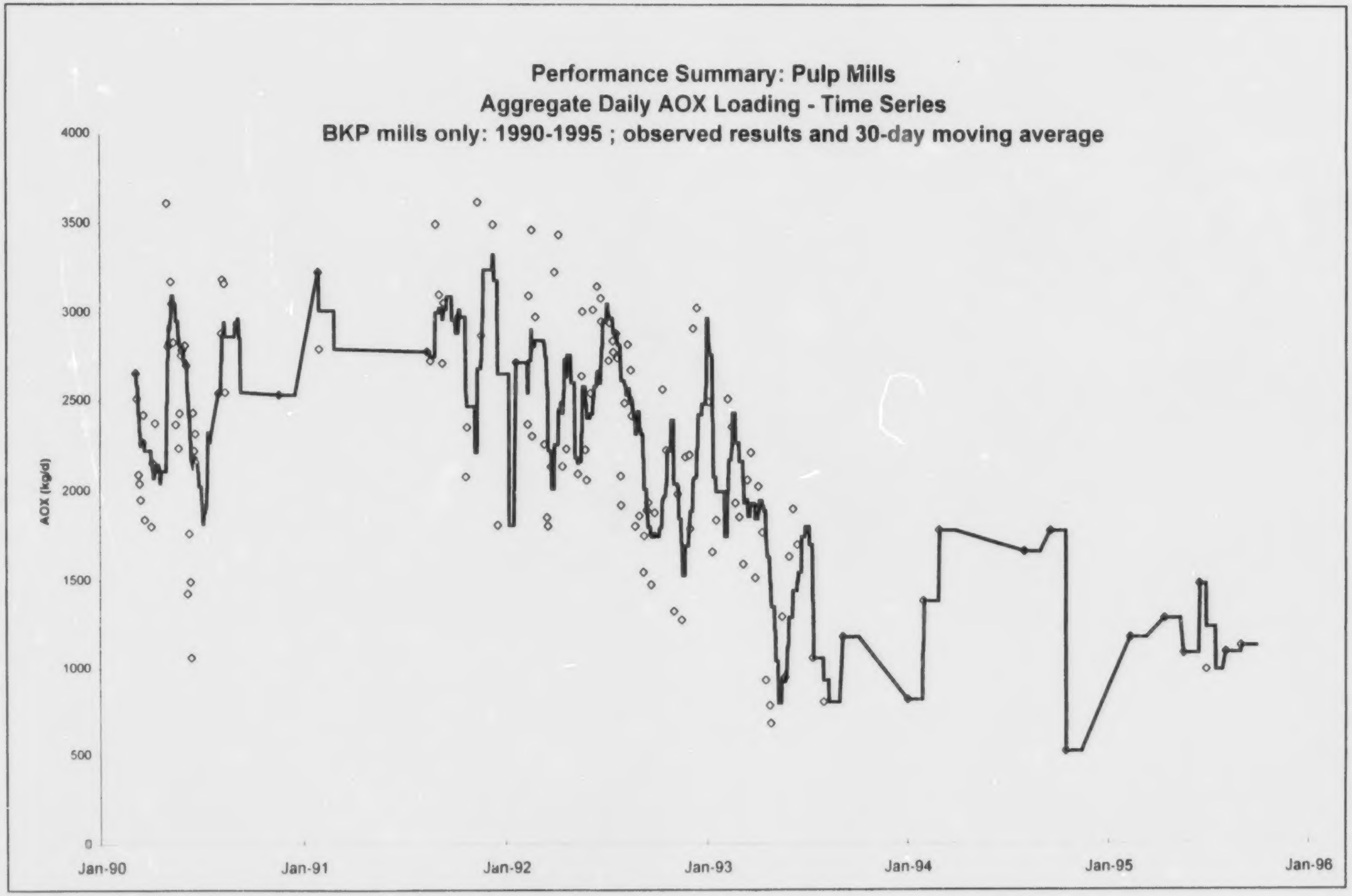
Unlike the other parameters examined within this sector, only timeseries are presented for each of these. The data are presented in both kg/d and in mg/l. No statistical analysis of any kind was done, including the presentation of histograms and pie-charts.

Given that these parameters were frequently reported with respect to a given detection limit, the data points on the resultant plots were necessarily subdivided into two categories: known values, and non-detectable values. The non-detectable values were further subdivided depending upon whether or not a detection limit was specified in the effluent monitoring report. While *referenced* non-detectables (those with a known detection level) were plotted on the timeseries charts, *unreferenced* non-detectables (those without a specified detection level) could not be plotted. Instead, the number of known values, referenced non-detectables and unreferenced non-detectables were presented via a tabular summary for each substance of interest.

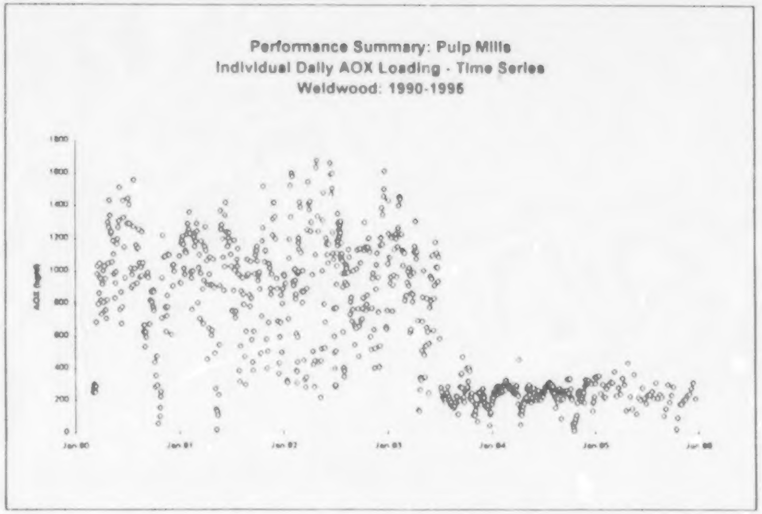
For the specific case of monitoring data for 2,3,7,8-TCDD and 2,3,7,8-TCDF from 1992 to the present, a fourth criterion, the non-measurable level was also considered. The non-measurable level has been set by Canadian federal government regulation to have a value of 15 pg/l for

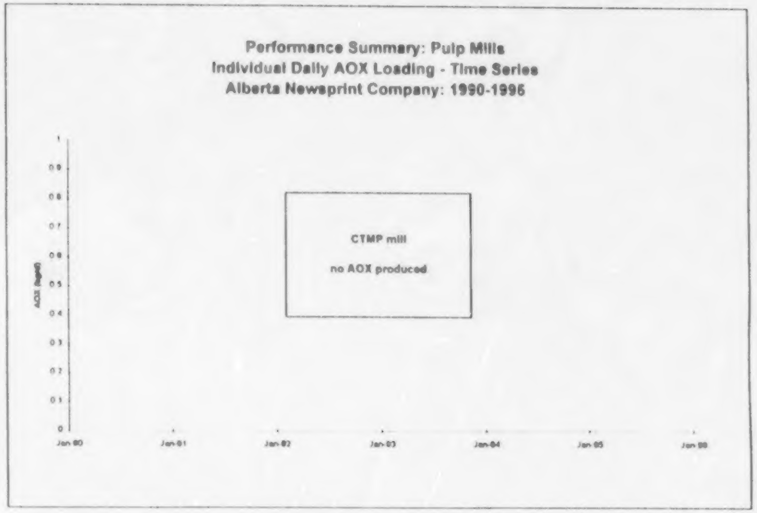
2,3,7,8-TCDD and 50 mg/l for 2,3,7,8-TCDF. Therefore, for 2,3,7,8-TCDD, any values from 1992 to present that are below 15 pg/l are considered non-measurable; for 2,3,7,8-TCDF, any values from 1992 to present that are below 50 pg/l are considered non-measurable. If a given measurement is above the detection level but below the non-measurable level, such measurement is considered non-measurable. Therefore, for these two substances only, the total number of non-measurables is also stated for each mill.

Adsorbable Halogenated Organics
(AOX)



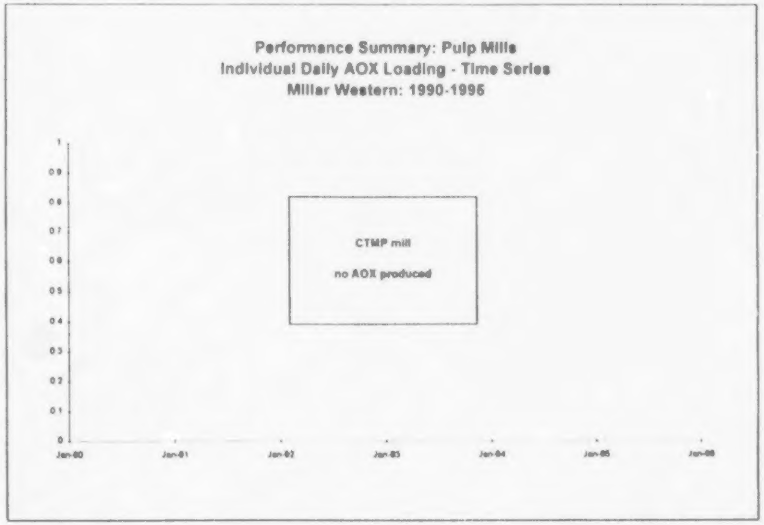
Performance Summary: Pulp Mills
Aggregate Daily AOX Loading - Time Series
BKP mills only: 1990-1995 ; observed results and 30-day moving average


Performance Summary: Pulp Mills
Individual Daily AOX Loading - Time Series
Weldwood: 1990-1996


Performance Summary: Pulp Mills
Individual Daily AOX Loading - Time Series
Alberta Newsprint Company: 1990-1996

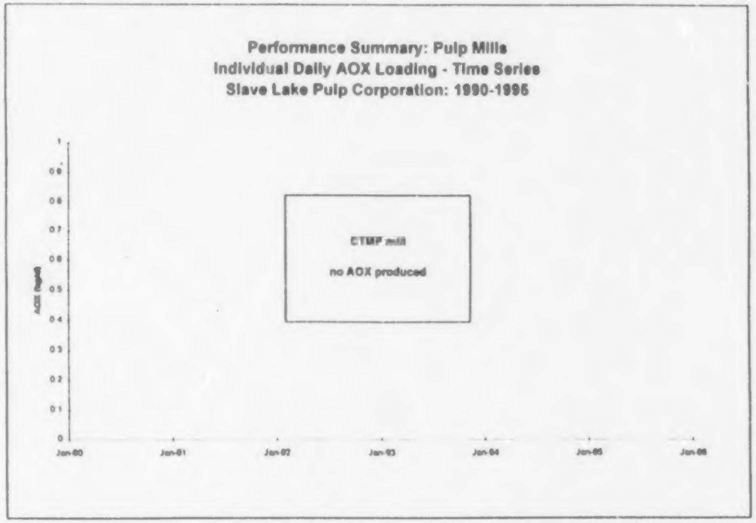
CTMP mill

no AOX produced


Performance Summary: Pulp Mills
Individual Daily AOX Loading - Time Series
Millar Western: 1990-1995

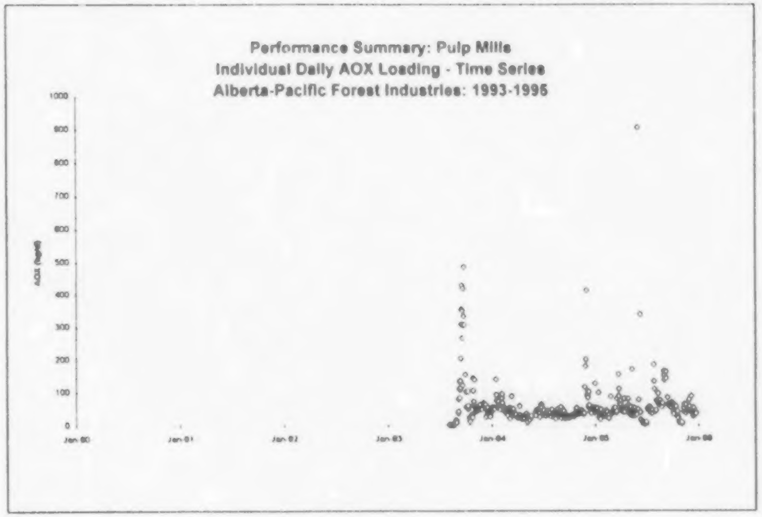
CTMP mill

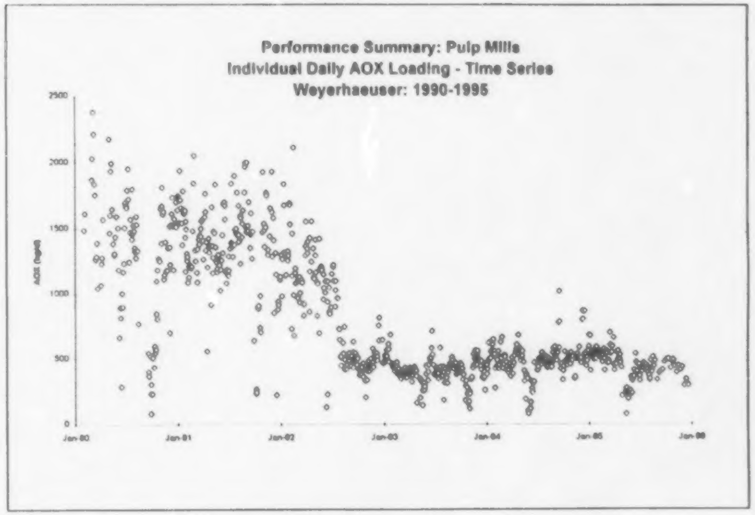
no AOX produced

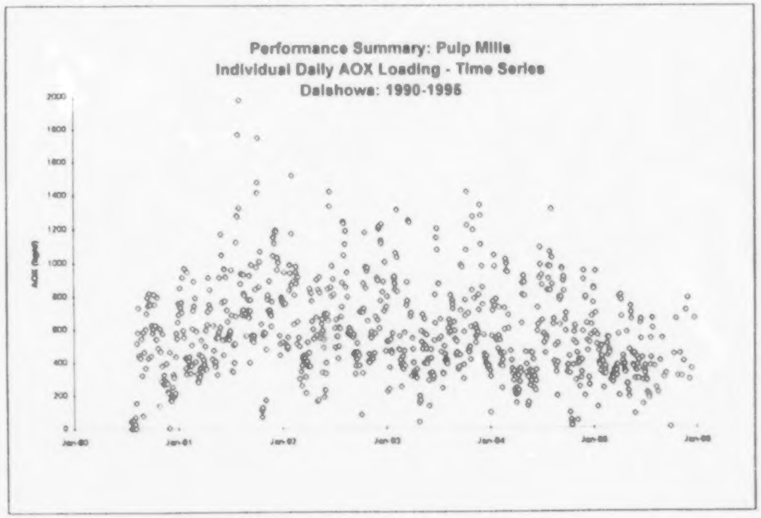

Performance Summary: Pulp Mills
Individual Daily AOX Loading - Time Series
Slave Lake Pulp Corporation: 1990-1996

CTMP mill

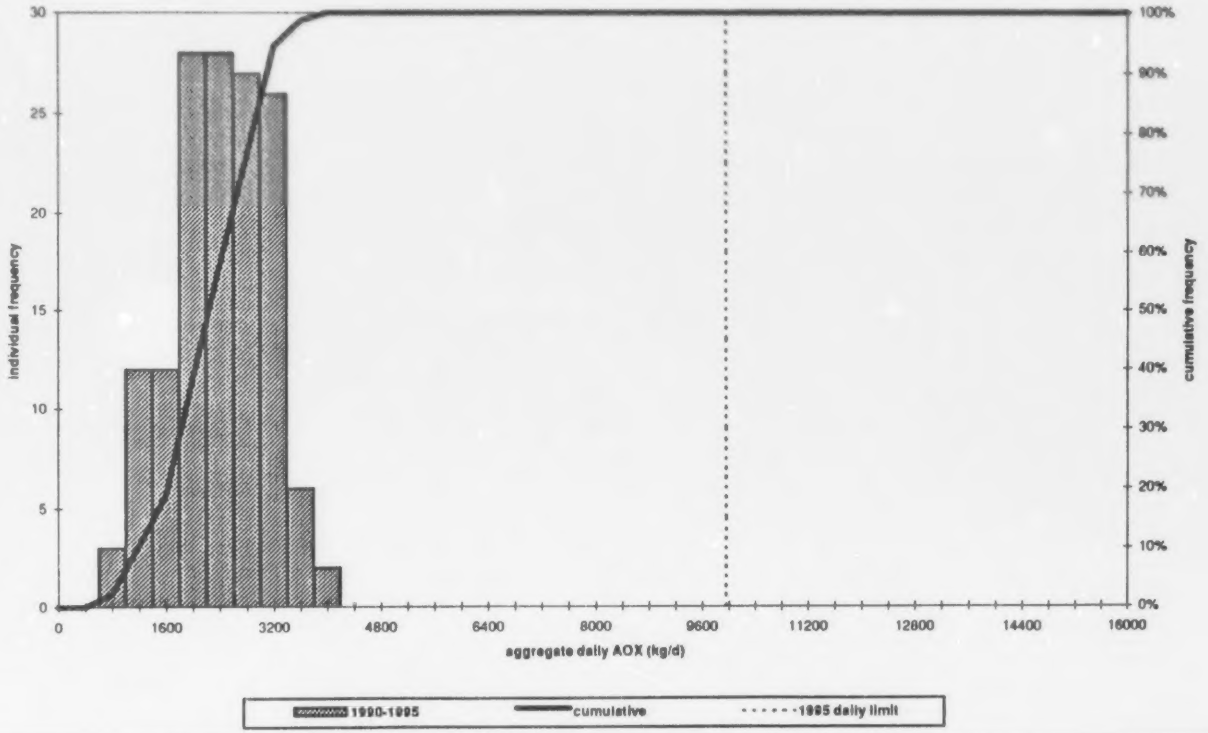
no AOX produced

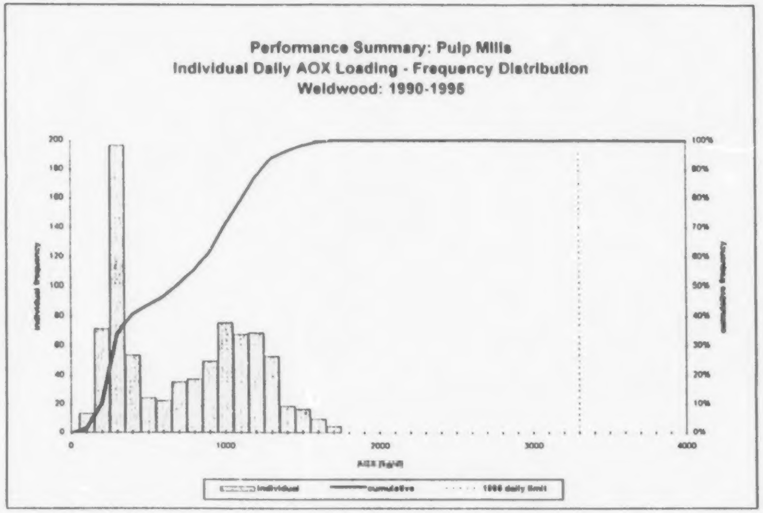

Performance Summary: Pulp Mills
Individual Daily AOX Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1995

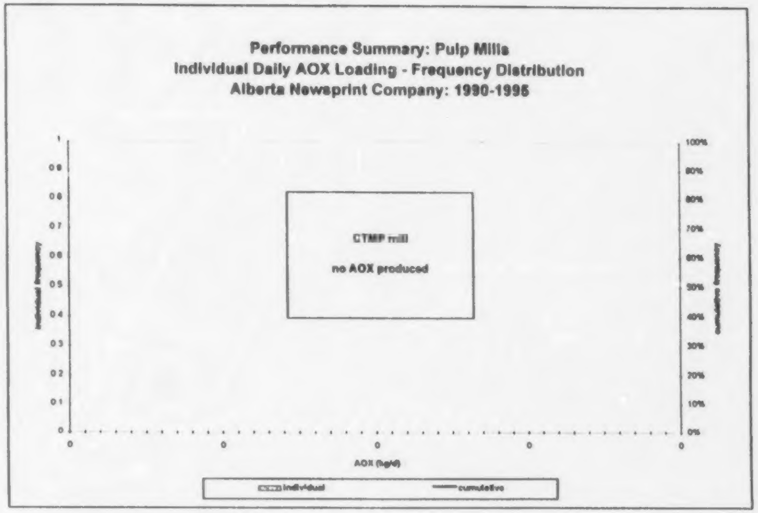

Performance Summary: Pulp Mills
Individual Daily AOX Loading - Time Series
Weyerhaeuser: 1990-1995

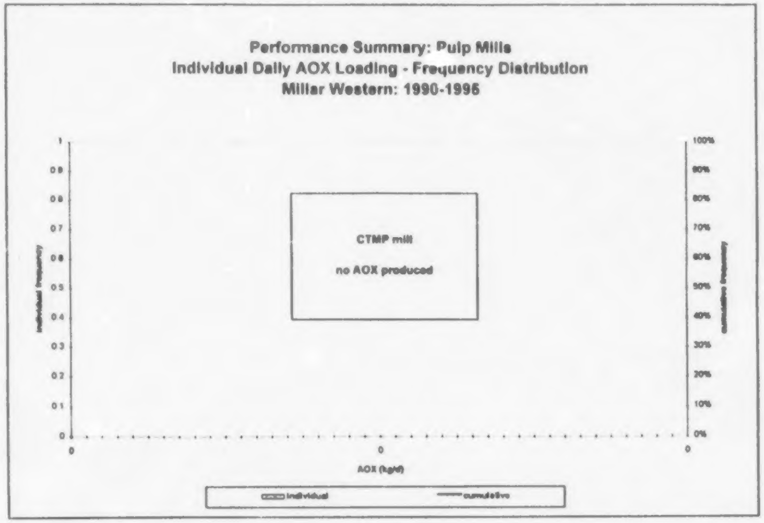

Performance Summary: Pulp Mills
Individual Daily AOX Loading - Time Series
Daishowa: 1990-1995

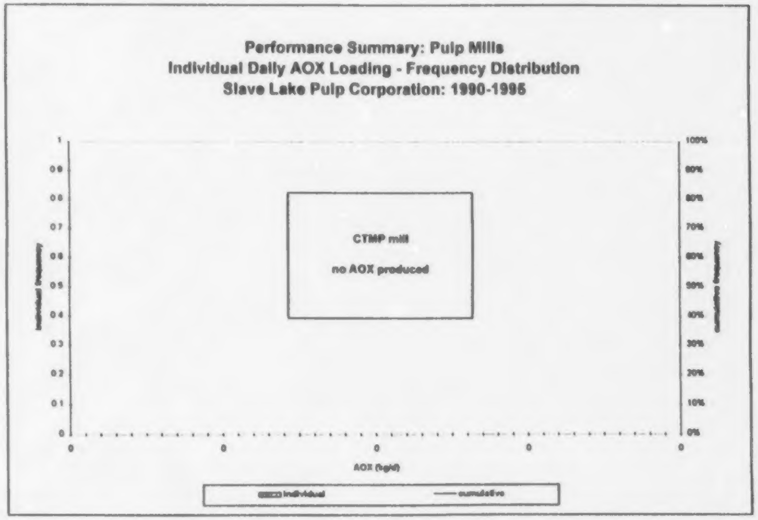
Performance Summary: Pulp Mills
Aggregate Daily AOX Loading - Frequency Distribution
BKP mills only: 1990-1995



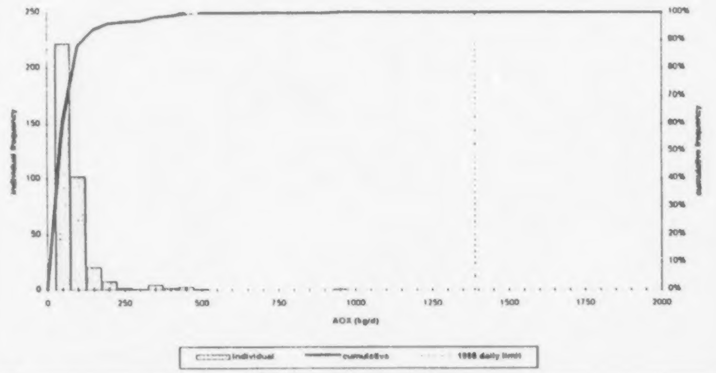

Performance Summary: Pulp Mills
Individual Daily AOX Loading - Frequency Distribution
Weldwood: 1990-1995


Performance Summary: Pulp Mills
Individual Daily AOX Loading - Frequency Distribution
Alberta Newsprint Company: 1990-1995

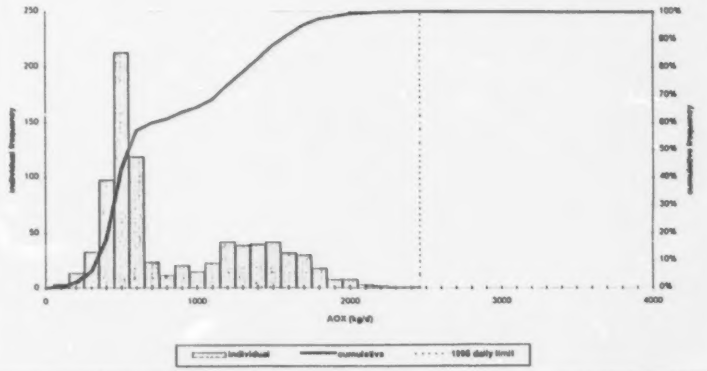

Performance Summary: Pulp Mills
Individual Daily AOX Loading - Frequency Distribution
Millar Western: 1990-1995


Performance Summary: Pulp Mills
Individual Daily AOX Loading - Frequency Distribution
Slave Lake Pulp Corporation: 1990-1995

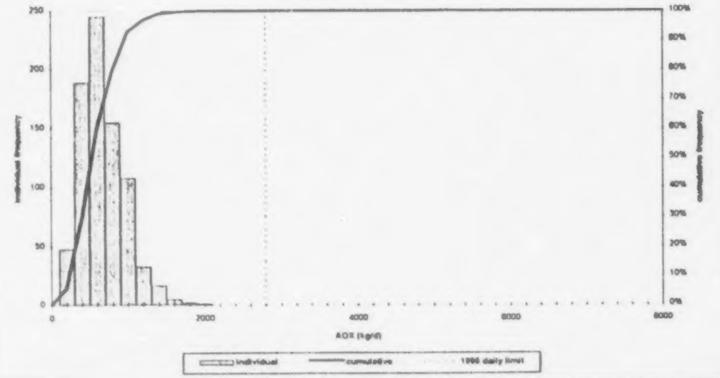
Performance Summary: Pulp Mills
Individual Daily AOX Loading - Frequency Distribution
Alberta-Pacific Forest Industries: 1993-1995



Performance Summary: Pulp Mills
Individual Daily AOX Loading - Frequency Distribution
Weyerhaeuser: 1990-1995



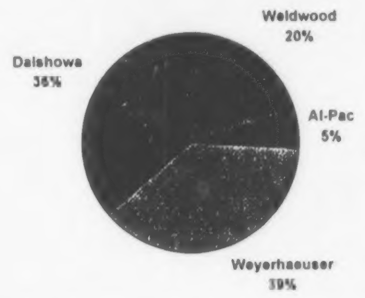
Performance Summary: Pulp Mills
Individual Daily AOX Loading - Frequency Distribution
Daishowa: 1990-1995



Performance Summary: Pulp Mills

Average Daily AOX Loading for 1995

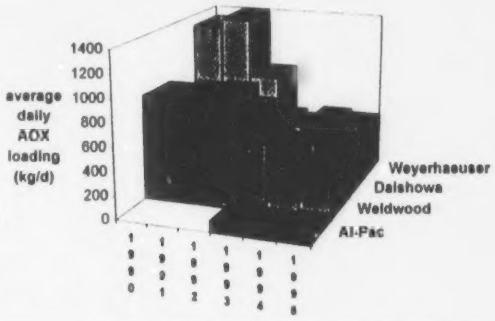
100% = 1175.9 kg/d aggregate AOX loading
BKP mills only



Performance Summary: Pulp Mills

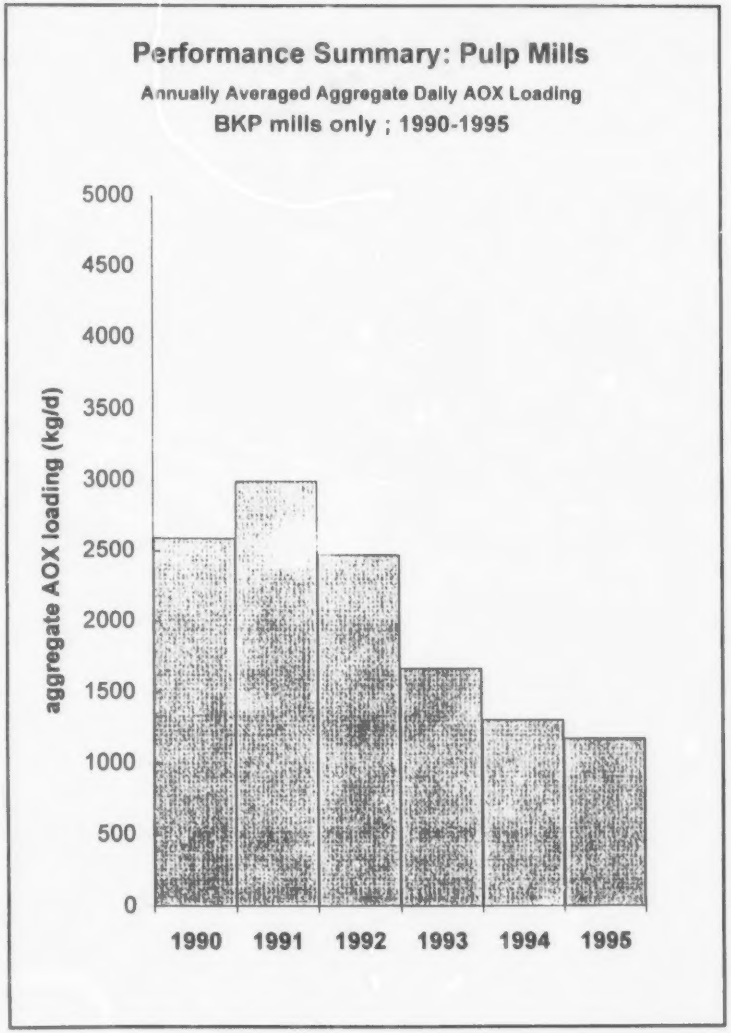
Annually Averaged Daily AOX Loading

BKP mills only ; 1990-1995



AOX: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

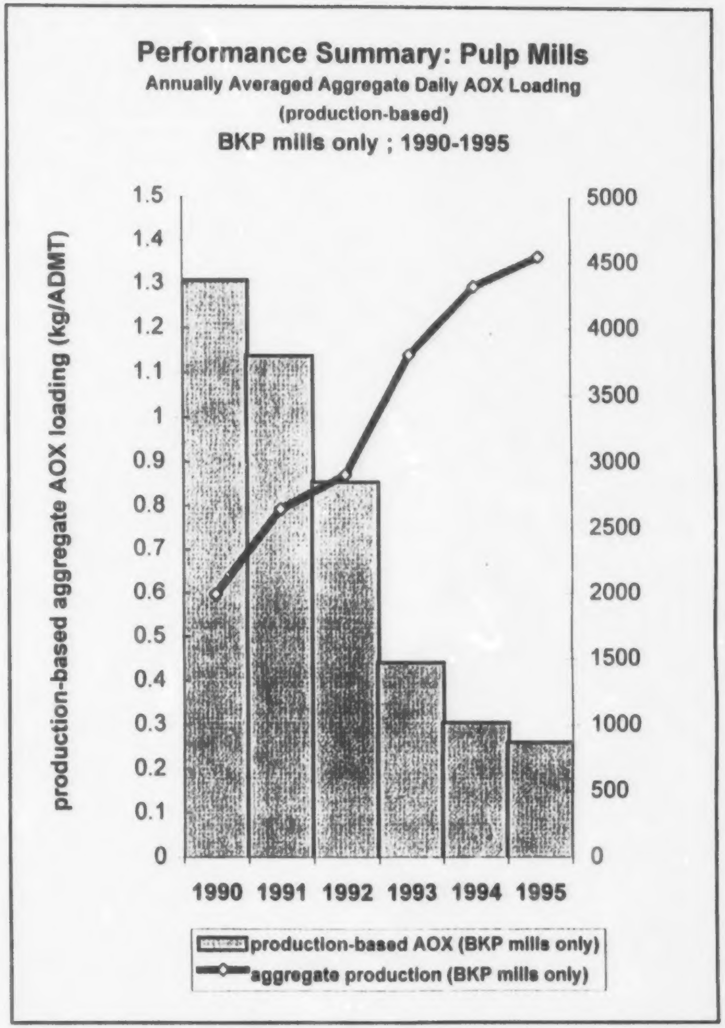
	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
mill	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Weldwood	891.3	329.2	924.9	307.8	942.4	359.4	672.8	415.4	239.2	64.2	240.8	76.7	3300	1650
ANC													n/a	n/a
Millar Western													n/a	n/a
Slave Lake													n/a	n/a
Al-Pac							96.3	115.0	46.2	40.5	61.5	80.8	1390	818
Weyerhaeuser	1301.7	472.4	1380.2	332.1	862.5	397.7	403.9	96.9	481.7	130.1	449.0	110.8	2460	1230
Daishowa	399.3	237.6	692.5	310.5	669.3	269.9	598.2	281.6	541.7	268.6	424.6	181.2	2800	1400



Performance Summary: Pulp Mills

Annually Averaged Aggregate Daily AOX Loading

BKP mills only ; 1990-1995



Performance Summary: Pulp Mills

Annually Averaged Aggregate Daily AOX Loading

(production-based)

BKP mills only ; 1990-1995

Pulp Mills: production based summary of AOX loading
all mills ; 1990-1995

		average daily AOX loading (kg/d):							aggregate:	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa	to Athabasca	to all
total samples 1990-1995:		826	n/a	n/a	n/a	368	826	826		
average for:	1990	891.3	[redacted]	[redacted]	[redacted]		1301.7	399.3	891.3	2592.3
	1991	924.9	[redacted]	[redacted]	[redacted]		1380.2	692.5	924.9	2997.7
	1992	942.4	[redacted]	[redacted]	[redacted]		862.5	669.3	942.4	2474.2
	1993	572.8	[redacted]	[redacted]	[redacted]	96.3	403.9	598.2	669.2	1671.3
	1994	239.2	[redacted]	[redacted]	[redacted]	46.2	481.7	541.7	285.4	1308.8
	1995	240.8	[redacted]	[redacted]	[redacted]	61.5	449.0	424.6	302.2	1175.9
	1990-1995	679.6	[redacted]	[redacted]	[redacted]	62.4	802.9	578.5	742.0	2123.4

aggregate limits for 1995:

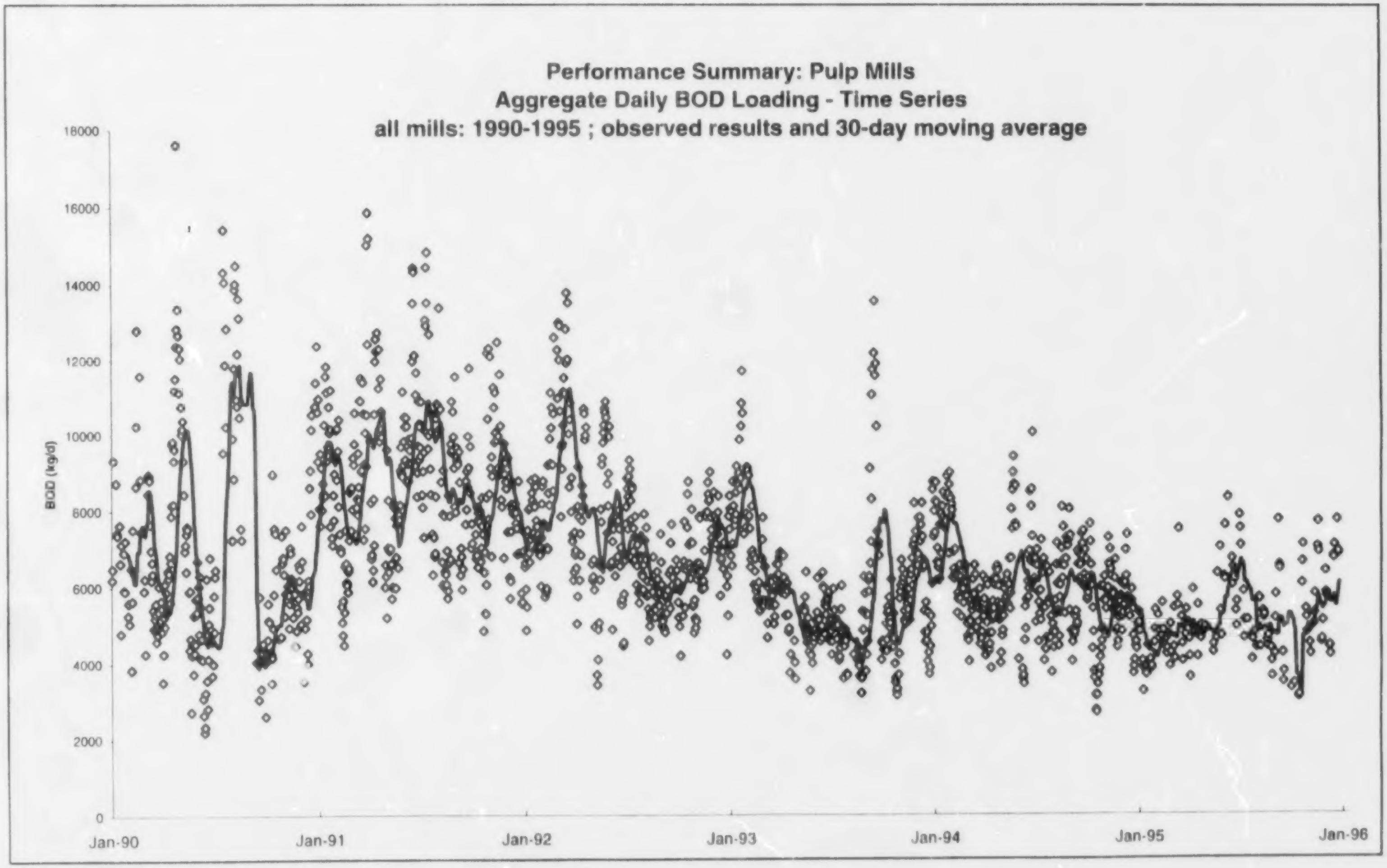
daily (kg/d) =
9950

monthly (kg/d) =
5098

		average daily production (ADMTD):							aggregate production:			
									all plants:		*BKP plants only:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa	to Athabasca	to all	to Athabasca	to all
average for:	1990	713.6	337.4	576.3	-		774.4	497.1	1627.3	2898.8	713.6	1985.1
	1991	982.7	493.2	606.3	212.7		847.3	809.3	2294.8	3951.4	982.7	2639.2
	1992	1045.4	587.6	608.3	322.2		852.8	1002.5	2563.5	4418.8	1045.4	2900.7
	1993	1046.7	614.0	532.3	325.9	866.1	836.8	1048.8	3385.0	5270.6	1912.8	3798.4
	1994	1082.3	634.0	692.2	365.2	1332.7	864.3	1034.6	4106.5	6005.4	2415.1	4314.0
	1995	1101.2	655.4	679.3	344.7	1473.4	847.8	1121.6	4254.1	6223.5	2574.6	4544.1
	1990-1995	998.7	581.4	615.8	315.9	1317.3	838.4	963.5	3829.1	5631.0	2316.0	4117.9

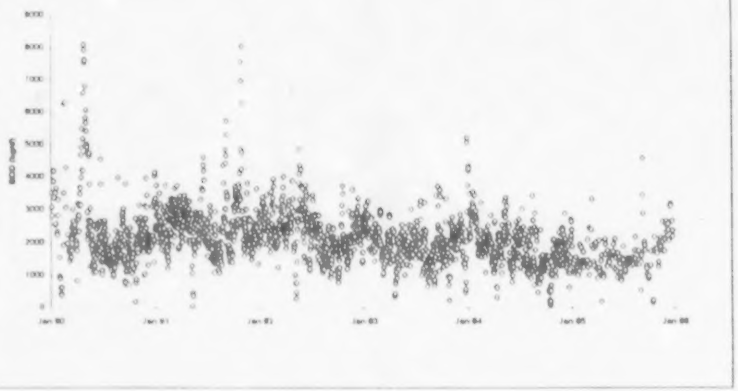
		average daily production-based AOX loading (kg AOX/ADMT produced):							ratio of aggregates:			
									all plants:		*BKP plants only:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa	to Athabasca	to all	to Athabasca	to all
average for:	1990	1.25	[redacted]	[redacted]	[redacted]		1.68	0.80	0.55	0.89	1.25	1.31
	1991	0.94	[redacted]	[redacted]	[redacted]		1.63	0.86	0.40	0.76	0.94	1.14
	1992	0.90	[redacted]	[redacted]	[redacted]		1.01	0.67	0.37	0.56	0.90	0.85
	1993	0.55	[redacted]	[redacted]	[redacted]	0.11	0.48	0.57	0.20	0.32	0.35	0.44
	1994	0.22	[redacted]	[redacted]	[redacted]	0.03	0.56	0.52	0.07	0.22	0.12	0.30
	1995	0.22	[redacted]	[redacted]	[redacted]	0.04	0.53	0.38	0.07	0.19	0.12	0.26
	1990-1995	0.68	[redacted]	[redacted]	[redacted]	0.05	0.96	0.60	0.19	0.38	0.32	0.52

Biochemical Oxygen Demand
(BOD)

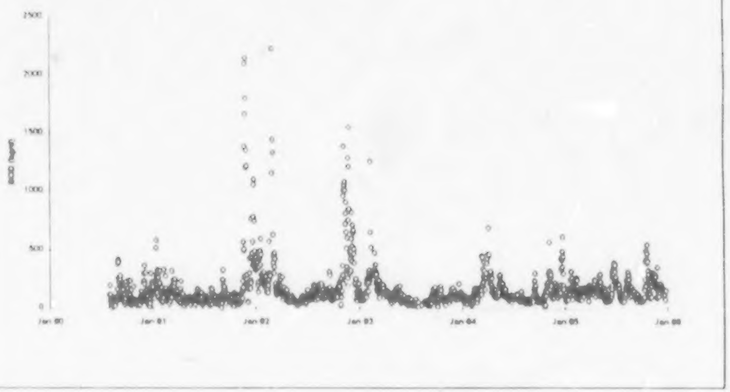


Performance Summary: Pulp Mills
Aggregate Daily BOD Loading - Time Series
all mills: 1990-1995 ; observed results and 30-day moving average

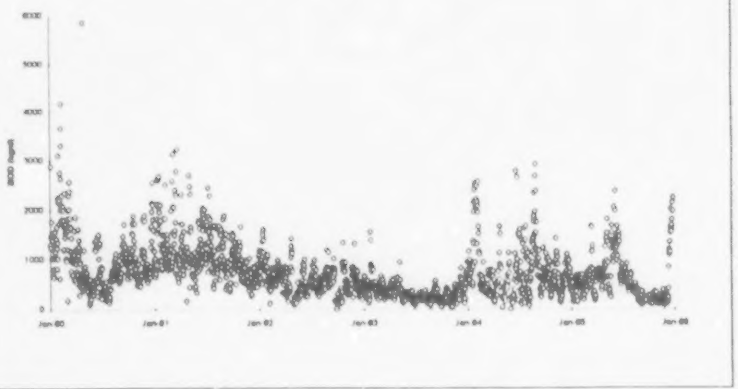
Performance Summary: Pulp Mills
Individual Daily BOD Loading - Time Series
Weldwood: 1990-1995



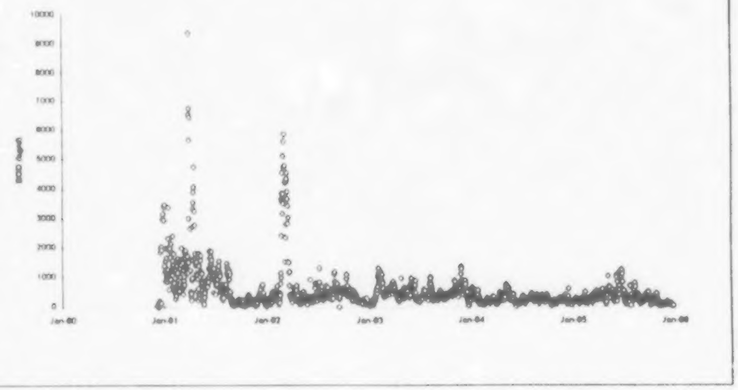
Performance Summary: Pulp Mills
Individual Daily BOD Loading - Time Series
Alberta Newsprint Company: 1990-1995



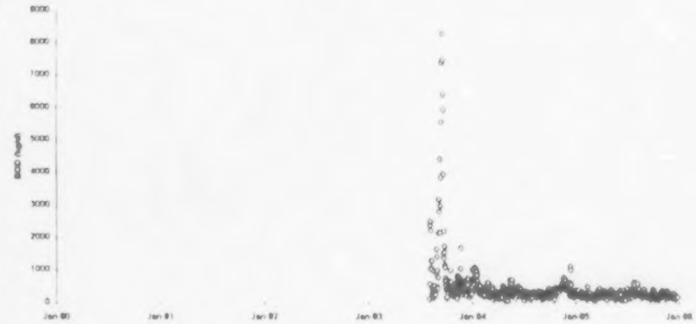
Performance Summary: Pulp Mills
Individual Daily BOD Loading - Time Series
Millar Western: 1990-1995



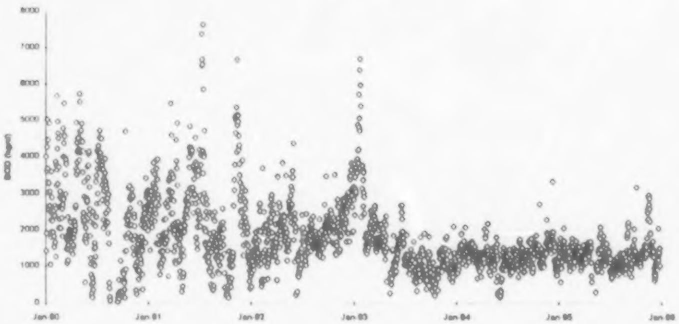
Performance Summary: Pulp Mills
Individual Daily BOD Loading - Time Series
Slave Lake Pulp Corporation: 1990-1995



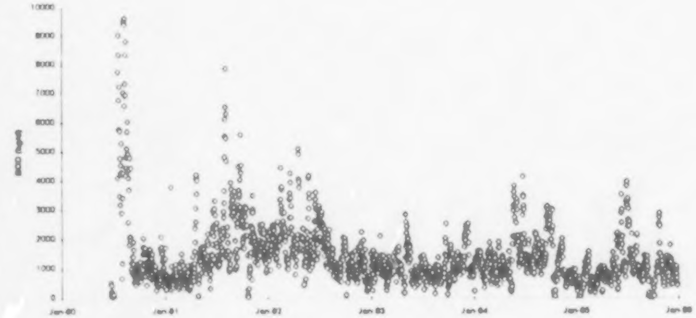
Performance Summary: Pulp Mills
Individual Daily BOD Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1996

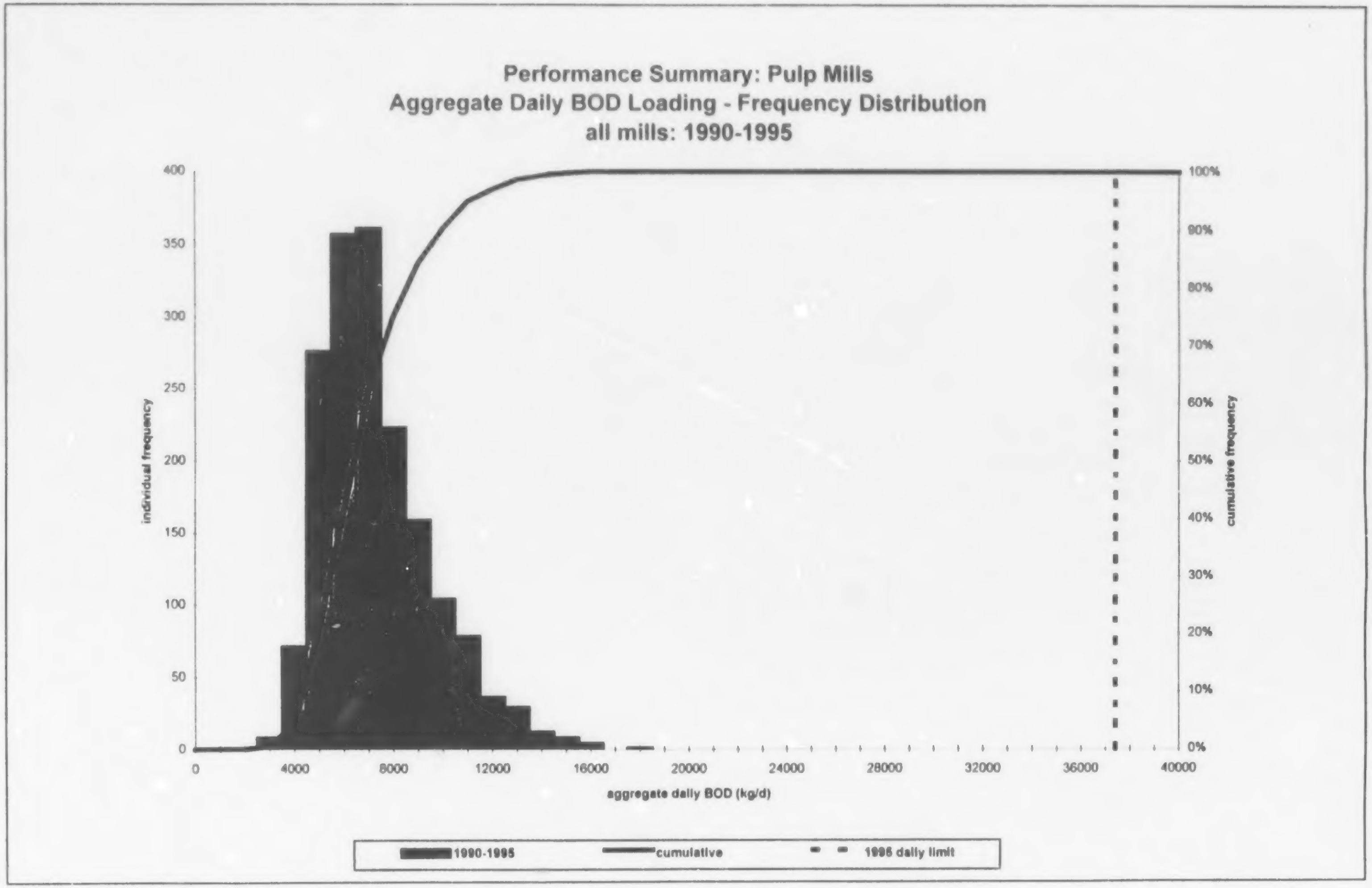


Performance Summary: Pulp Mills
Individual Daily BOD Loading - Time Series
Weyerhaeuser: 1990-1996



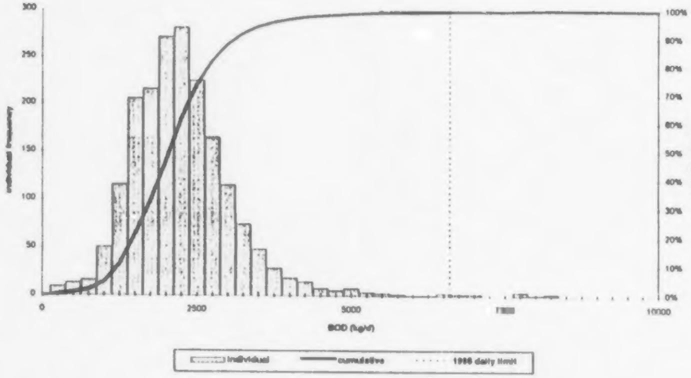
Performance Summary: Pulp Mills
Individual Daily BOD Loading - Time Series
Dalshowa: 1990-1996



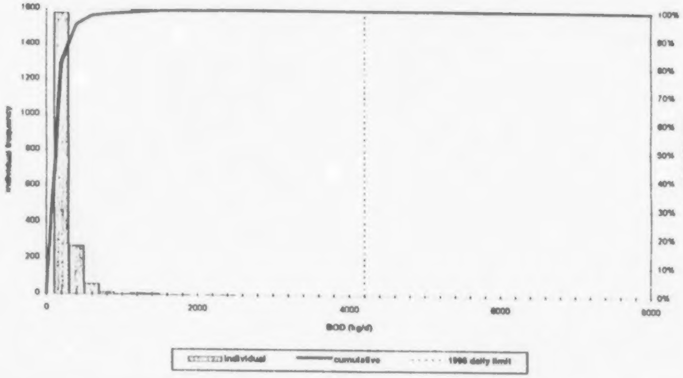


Performance Summary: Pulp Mills
Aggregate Daily BOD Loading - Frequency Distribution
all mills: 1990-1995

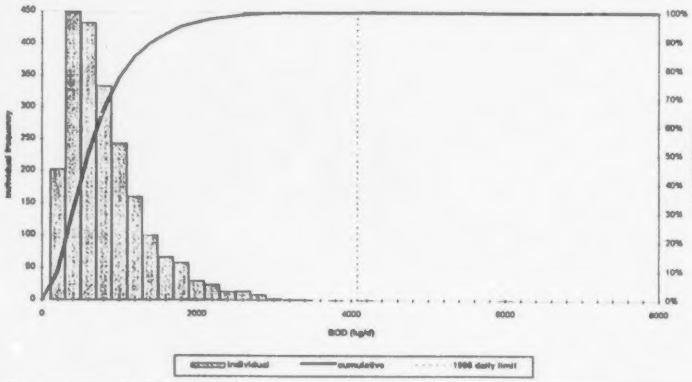
Performance Summary: Pulp Mills
Individual Daily BOD Loading - Frequency Distribution
Weldwood: 1990-1995



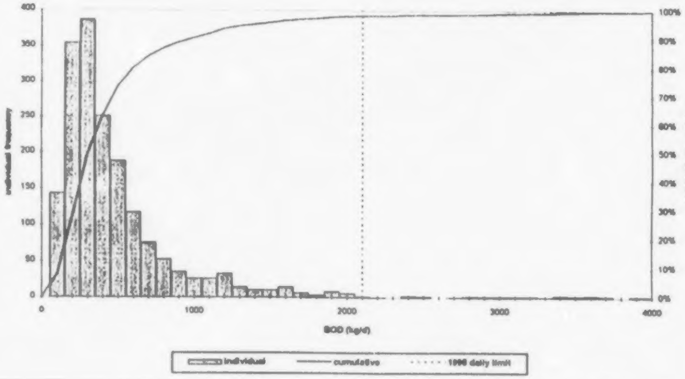
Performance Summary: Pulp Mills
Individual Daily BOD Loading - Frequency Distribution
Alberta Newsprint Company: 1990-1995



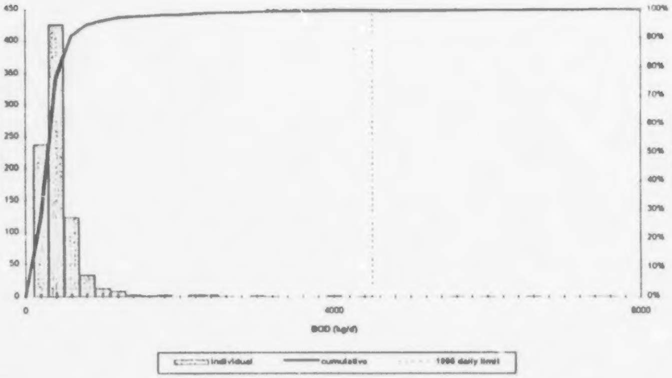
Performance Summary: Pulp Mills
Individual Daily BOD Loading - Frequency Distribution
Millar Western: 1990-1995



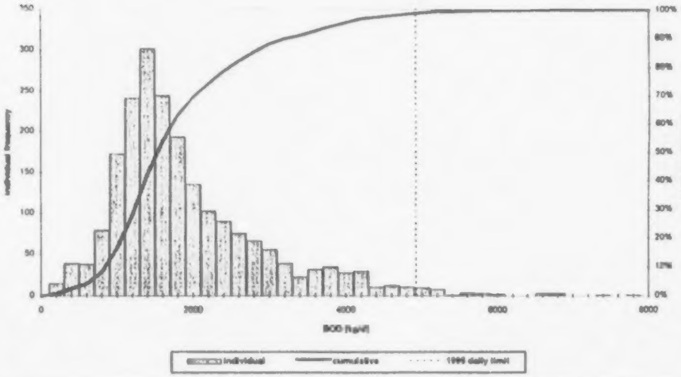
Performance Summary: Pulp Mills
Individual Daily BOD Loading - Frequency Distribution
Slave Lake Pulp Corporation: 1990-1995



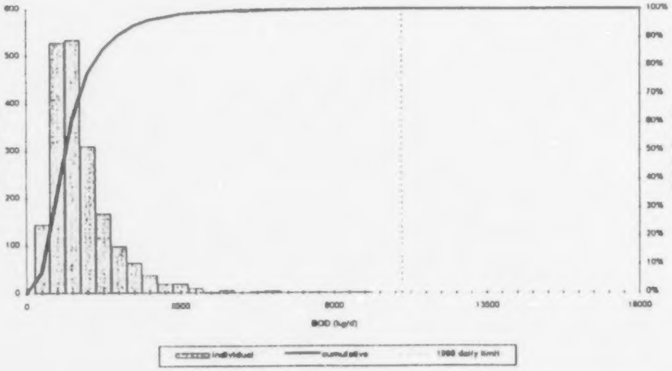
Performance Summary: Pulp Mills
Individual Daily BOD Loading - Frequency Distribution
Alberta-Pacific Forest Industries: 1993-1995

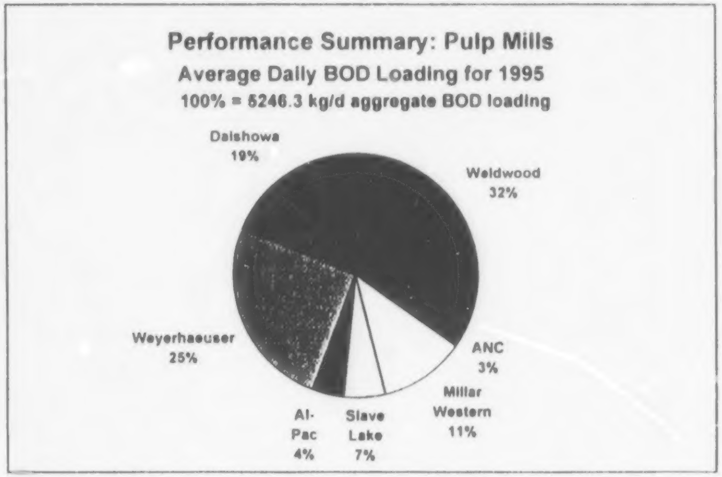


Performance Summary: Pulp Mills
Individual Daily BOD Loading - Frequency Distribution
Weyerhaeuser: 1990-1995



Performance Summary: Pulp Mills
Individual Daily BOD Loading - Frequency Distribution
Daishowa: 1990-1995

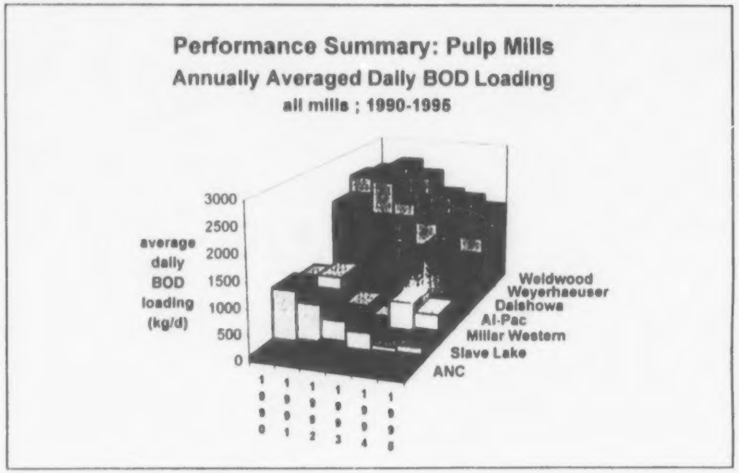




Performance Summary: Pulp Mills

Average Daily BOD Loading for 1995

100% = 5246.3 kg/d aggregate BOD loading



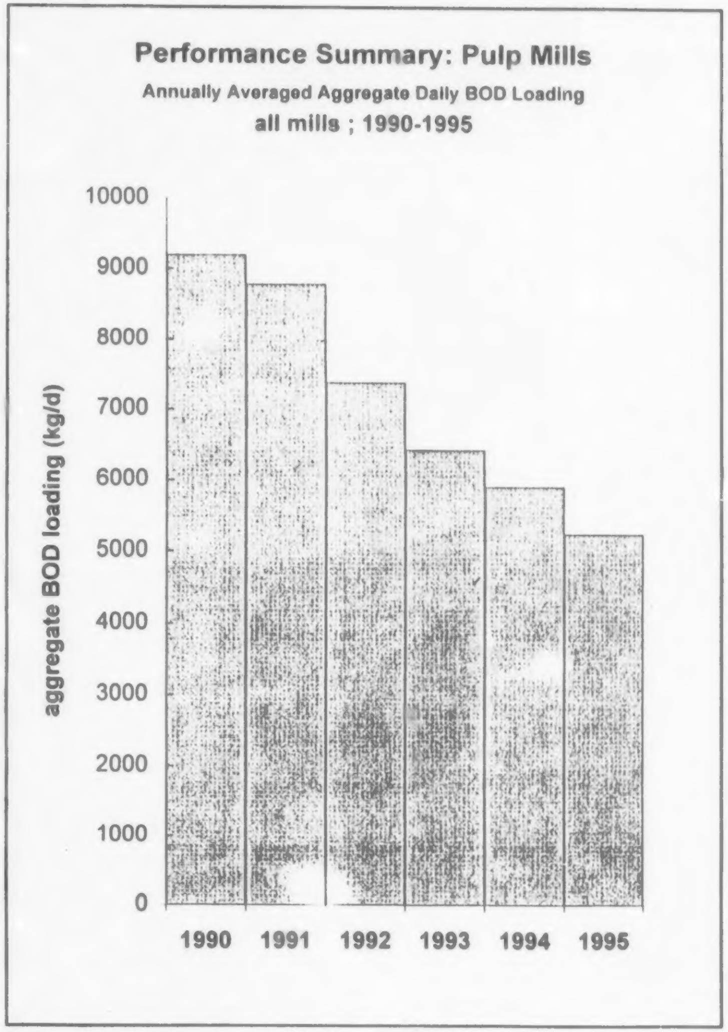
Performance Summary: Pulp Mills

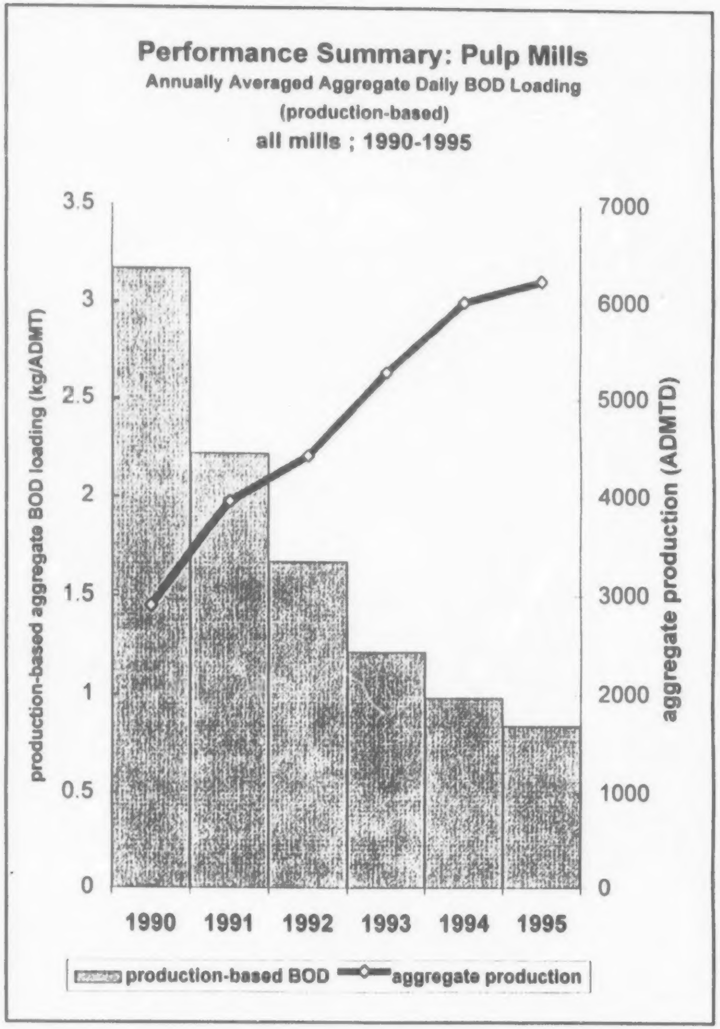
Annually Averaged Daily BOD Loading

all mills ; 1990-1995

BOD: *calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995*

	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
mill	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Weldwood	2381.9	1300.6	2549.3	901.2	2328.6	719.1	1922.8	604.1	1829.8	716.6	1664.5	616.6	6600	3300
ANC	110.5	82.2	162.8	258.8	229.9	266.8	116.6	99.9	140.2	105.9	157.8	79.2	4200	2100
Millar Western	1016.1	658.0	1121.1	512.4	576.5	271.6	330.8	181.4	763.7	543.2	593.5	460.5	4080	2040
Slave Lake	1107.2	1316.6	887.4	1043.3	621.9	941.9	455.8	235.6	235.0	123.5	295.3	215.7	2100	1050
Al-Pac							993.9	1448.1	341.2	179.8	225.0	85.0	4500	2250
Weyerhaeuser	2473.7	1276.0	2384.3	1311.1	1948.1	669.6	1651.2	999.2	1280.7	349.4	1313.3	386.8	4920	2460
Daishowa	2105.1	2287.5	1681.6	1176.5	1681.9	842.8	1063.3	476.5	1326.0	733.5	997.0	663.7	11000	5500


Performance Summary: Pulp Mills
Annually Averaged Aggregate Daily BOD Loading
all mills ; 1990-1995


Performance Summary: Pulp Mills
Annually Averaged Aggregate Daily BOD Loading
(production-based)
all mills ; 1990-1995

Pulp Mills: summary of BOD loading all mills ; 1990-1995

		average daily BOD loading (kg/d): Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa	*aggregate:* to Athabasca	to all
total samples 1990-1995:		1923	1955	2156	1827	871	2115	1966		
average for:	1990	2381.9	110.5	1016.1	1107.2		2473.7	2105.1	4615.7	9194.5
	1991	2549.3	162.8	1121.1	887.4		2384.3	1681.6	4720.5	8786.4
	1992	2328.6	229.9	576.5	621.9		1948.1	1681.9	3756.9	7386.9
	1993	1922.8	116.6	330.8	455.8	993.9	1551.2	1063.3	3820.0	6434.5
	1994	1829.8	140.2	763.7	235.0	341.2	1280.7	1326.0	3309.9	5916.6
	1995	1664.5	157.3	593.5	295.3	225.0	1313.3	997.0	2936.0	5246.3
	1990-1995	2154.0	157.7	734.3	505.8	402.5	1819.8	1417.9	3954.3	7192.0

aggregate limits for 1995:

daily (kg/d)=
37400

monthly (kg/d)=
18700

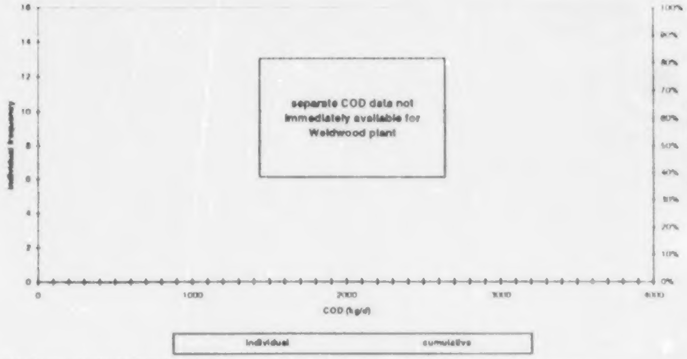
		average daily production (ADMTD): Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa	aggregate production: *all plants:* to Athabasca	to all
average for:	1990	713.6	337.4	576.3	-		774.4	497.1	1627.3	2898.8
	1991	982.7	493.2	606.3	212.7		847.3	809.3	2294.8	3951.4
	1992	1045.4	587.6	608.3	322.2		852.5	1002.5	2563.5	4418.8
	1993	1046.7	614.0	532.3	325.9	866.1	836.8	1048.8	3385.0	5270.6
	1994	1082.3	634.0	692.2	365.2	1332.7	864.3	1034.6	4106.5	6005.4
	1995	1101.2	655.4	679.3	344.7	1473.4	847.8	1121.6	4254.1	6223.5
	1990-1995	998.7	581.4	615.8	315.9	1317.3	838.4	963.5	3829.1	5631.0

		average daily production-based colour loading (kg colour /ADMT produced): Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa	*ratio of aggregates:* to Athabasca	to all
average for:	1990	3.34	0.33	1.76	-		3.19	4.23	2.84	3.17
	1991	2.59	0.33	1.85	4.17		2.81	2.08	2.06	2.22
	1992	2.23	0.39	0.95	1.93		2.28	1.68	1.47	1.67
	1993	1.84	0.19	0.62	1.40	1.16	1.86	1.01	1.13	1.22
	1994	1.69	0.22	1.10	0.64	0.26	1.48	1.28	0.81	0.99
	1995	1.61	0.24	0.87	0.86	0.15	1.65	0.89	0.69	0.84
	1990-1995	2.16	0.27	1.19	1.60	0.31	2.17	1.47	1.03	1.28

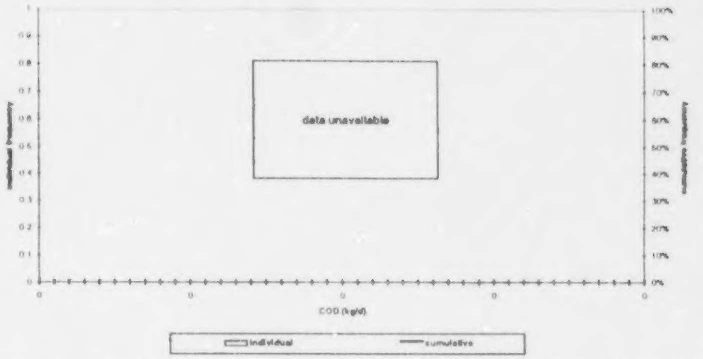
Chemical Oxygen Demand (COD)

Performance Summary: Pulp Mills
Aggregate Daily COD Loading - Frequency Distribution
all mills: 1990-1995

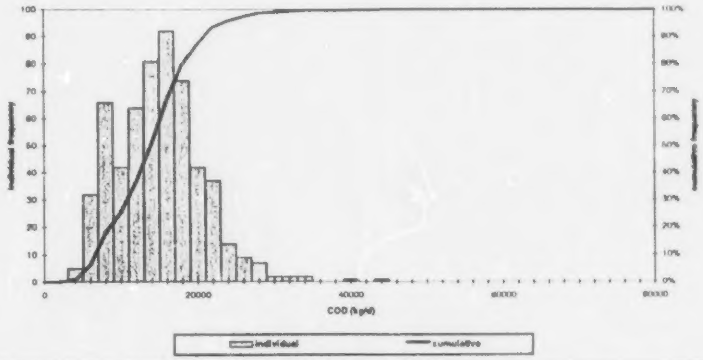
Performance Summary: Pulp Mills
Individual Daily COD Loading - Frequency Distribution
Weldwood: 1990-1995



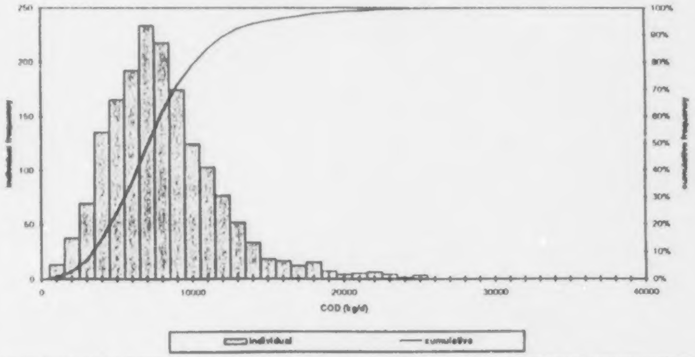
Performance Summary: Pulp Mills
Individual Daily COD Loading - Frequency Distribution
Alberta Newsprint Company: 1990-1995



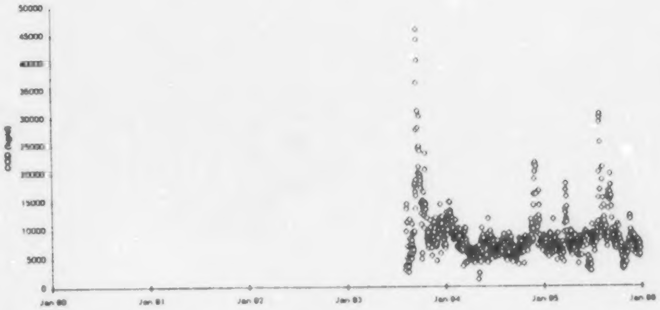
Performance Summary: Pulp Mills
Individual Daily COD Loading - Frequency Distribution
Millar Western: 1990-1995



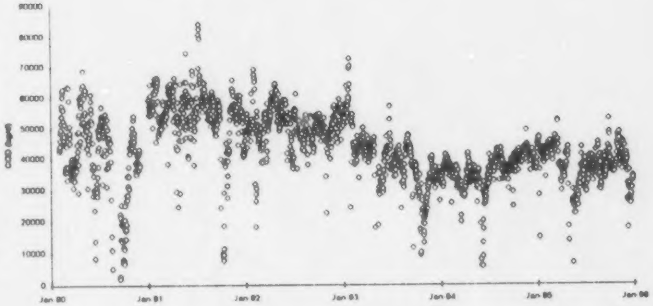
Performance Summary: Pulp Mills
Individual Daily COD Loading - Frequency Distribution
Slave Lake Pulp Corporation: 1990-1995



Performance Summary Pulp Mills
Individual Daily COD Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1995

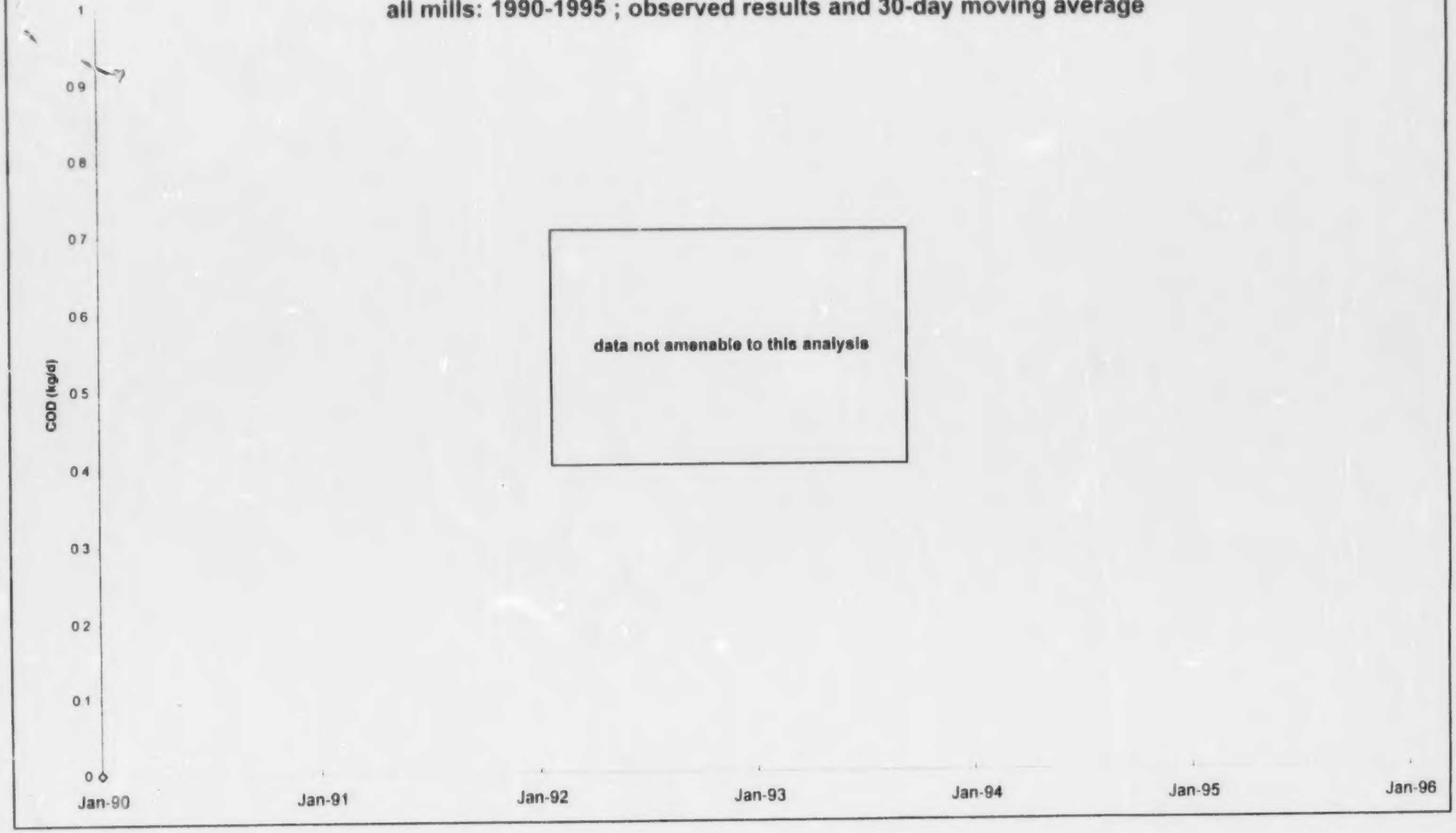


Performance Summary: Pulp Mills
Individual Daily COD Loading - Time Series
Weyerhaeuser: 1990-1995

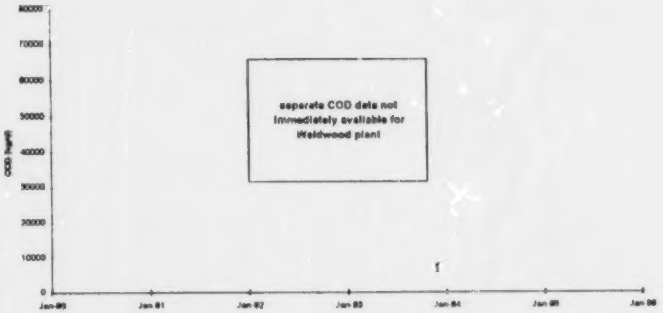


Performance Summary: Pulp Mills
Individual Daily COD Loading - Time Series
Daishowa: 1990-1995

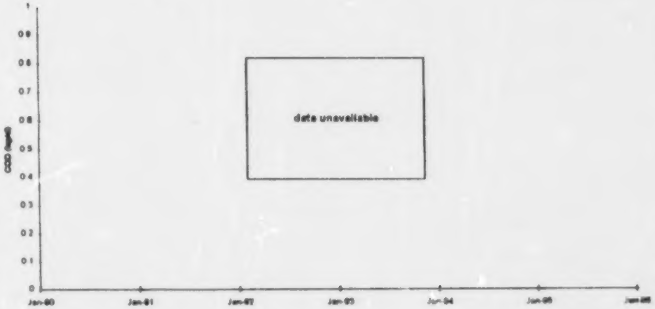
Performance Summary: Pulp Mills
Aggregate Daily COD Loading - Time Series
all mills: 1990-1995 ; observed results and 30-day moving average



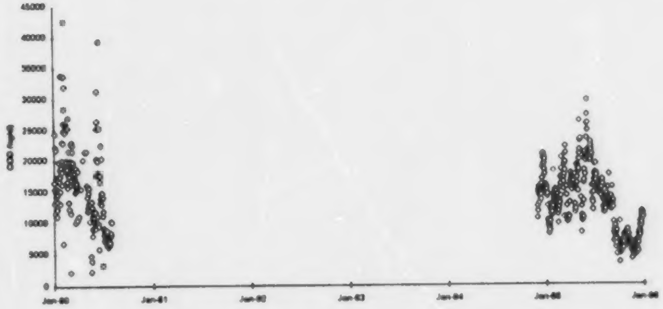
Performance Summary: Pulp Mills
Individual Daily COD Loading - Time Series
Weldwood: 1990-1995



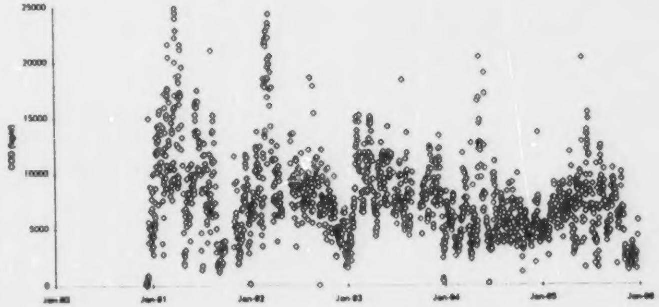
Performance Summary: Pulp Mills
Individual Daily COD Loading - Time Series
Alberta Newsprint Company: 1990-1995



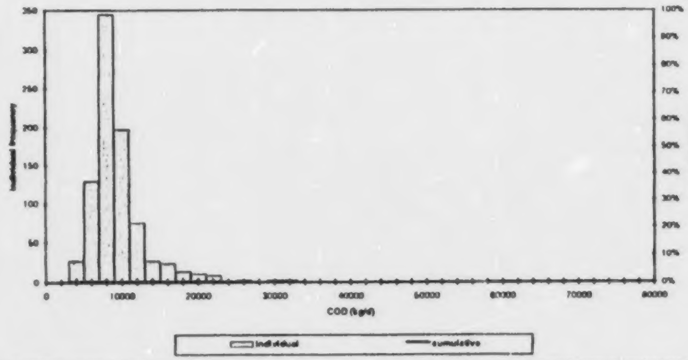
Performance Summary: Pulp Mills
Individual Daily COD Loading - Time Series
Millar Western: 1990-1995



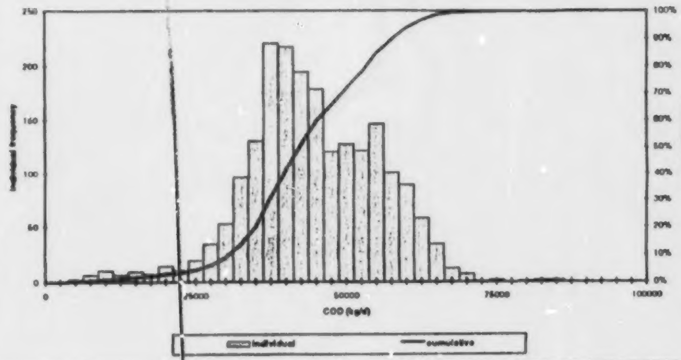
Performance Summary: Pulp Mills
Individual Daily COD Loading - Time Series
Slave Lake Pulp Corporation: 1990-1995



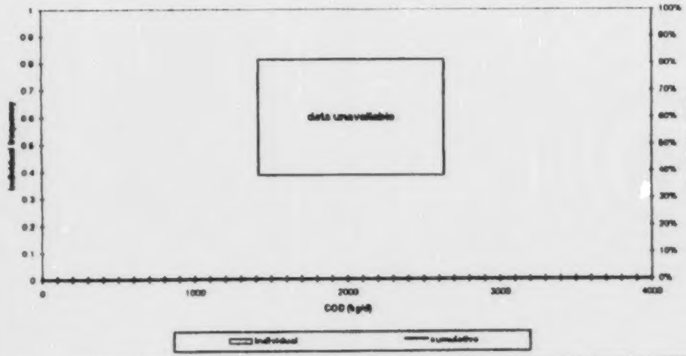
Performance Summary: Pulp Mills
Individual Daily COD Loading - Frequency Distribution
Alberta-Pacific Forest Industries: 1993-1995



Performance Summary: Pulp Mills
Individual Daily COD Loading - Frequency Distribution
Weyerhaeuser: 1990-1995



Performance Summary: Pulp Mills
Individual Daily COD Loading - Frequency Distribution
Daishowa: 1990-1995

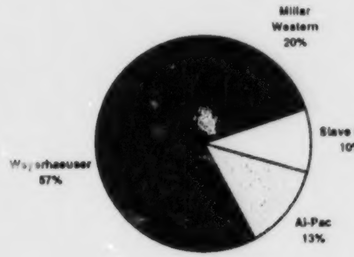


Performance Summary: Pulp Mills

Average Daily COD Loading for 1995

100% = 76694.5 kg/d aggregate COD loading

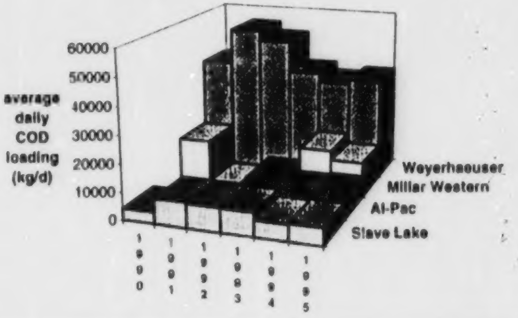
4 of 7 mills only



Performance Summary: Pulp Mills

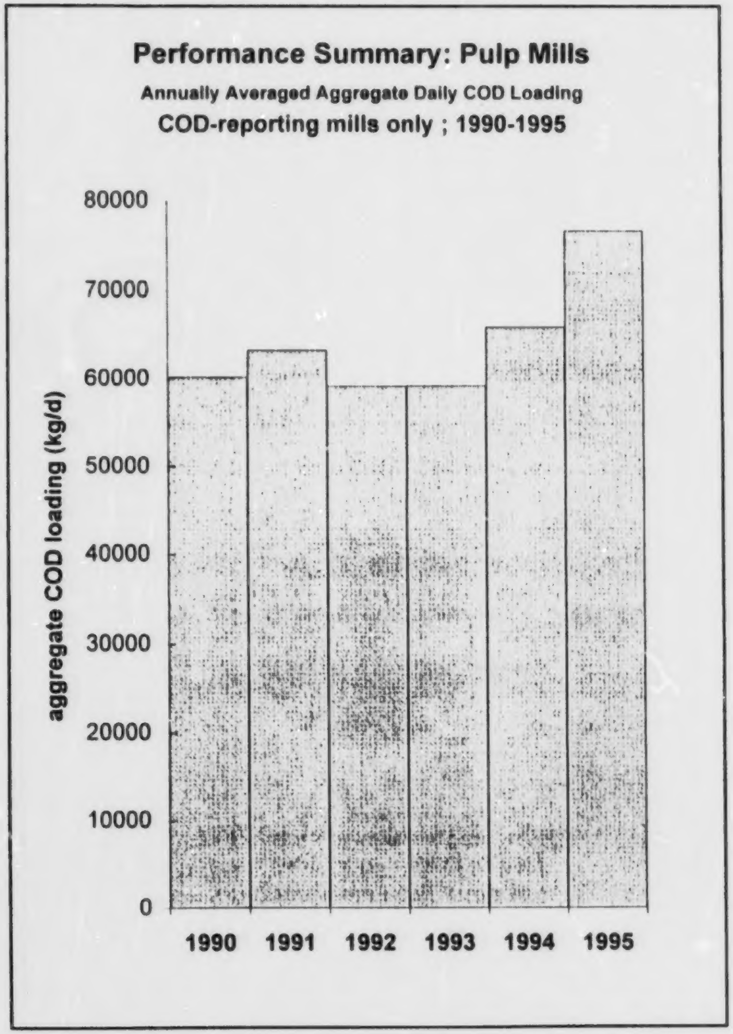
Annually Averaged Daily COD Loading

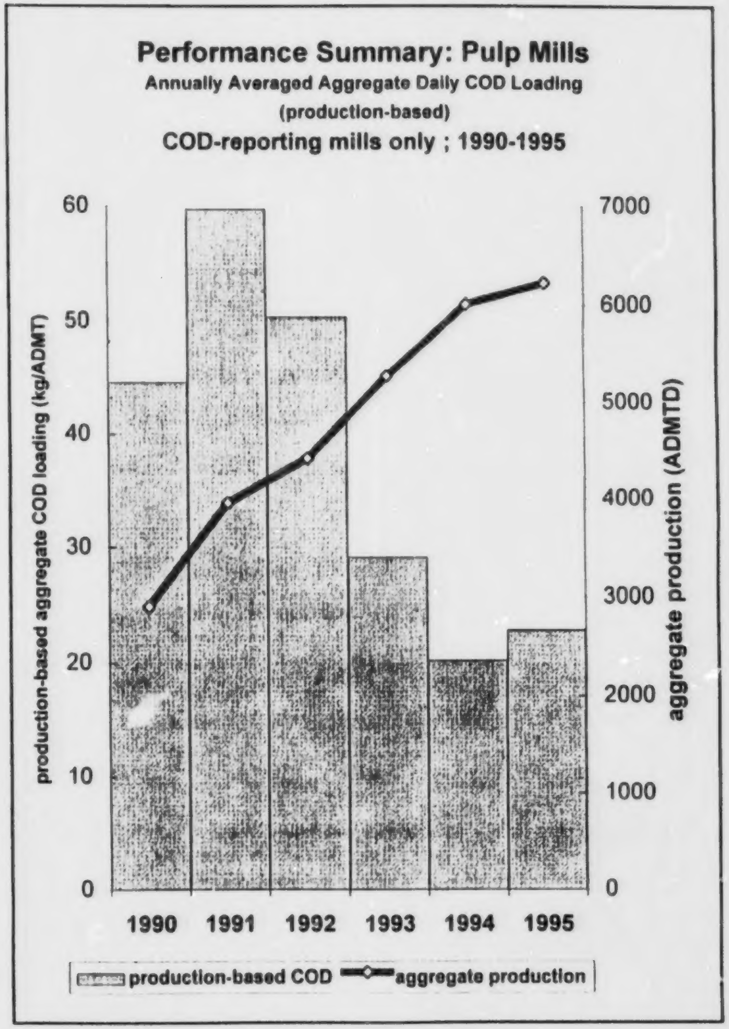
4 of 7 mills only ; 1990-1995



COD: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

mill	1990 x (kg/d)	s (kg/d)	1991 x (kg/d)	s (kg/d)	1992 x (kg/d)	s (kg/d)	1993 x (kg/d)	s (kg/d)	1994 x (kg/d)	s (kg/d)	1995 x (kg/d)	s (kg/d)	1995 imposed limits (kg/d): daily	monthly
Weldwood	-	-	-	-	-	-	-	-	-	-	11447.8	17534.0	none	none
ANC	-	-	-	-	-	-	-	-	-	-	-	-	none	none
Millar Western	15283.4	6732.6	-	-	-	-	-	-	16364.4	2788.1	12975.5	5007.9	none	none
Slave Lake	4211.1	3868.0	9158.4	4936.5	8652.0	4161.5	8533.1	2806.1	5956.9	2647.7	6305.7	2709.0	none	none
Al-Pac							11742.9	7377.3	7796.2	2834.3	8303.8	3612.8	none	none
Weyerhaeuser	40750.1	13700.6	54187.2	9972.7	50581.0	6405.5	38964.6	9447.1	35835.8	5597.2	37661.7	6251.3	none	none
Daishowa	-	-	-	-	-	-	-	-	-	-	-	-	none	none


Performance Summary: Pulp Mills
Annually Averaged Aggregate Daily COD Loading
COD-reporting mills only ; 1990-1995


Performance Summary: Pulp Mills
Annually Averaged Aggregate Daily COD Loading
(production-based)
COD-reporting mills only ; 1990-1995

Pulp Mills: summary of COD loading
all mills ; 1990-1995

		average daily COD loading (kg/d):							*aggregate:*	
		Weldwood	**ANC**	**Miller Western**	**Slave Lake**	**Al-Pac**	**Weyerhaeuser**	**Daishowa**	**to Athabasca**	**to all**
total samples 1990-1995:		50	0	573	1737	877	2053	0		
average for:	**1990**	-	-	15283.4	4211.1		40750.1	-	19494.5	60244.6
	1991	-	-	-	9158.4		54187.2	-	9158.4	63345.6
	1992	-	-	-	8652.0		50581.0	-	8652.0	59233.0
	1993	-	-	-	8533.1	11742.9	38964.6	-	20276.0	59240.6
	1994	-	-	16364.4	5956.9	7796.2	35835.8	-	30117.4	65953.2
	1995	11447.8	-	12975.5	6305.7	8303.8	37661.7	-	39032.8	76694.5
	1990-1995	11447.8	-	13908.0	7625.5	8676.8	43090.5	-	41658.1	84748.6

aggregate limits for 1995:

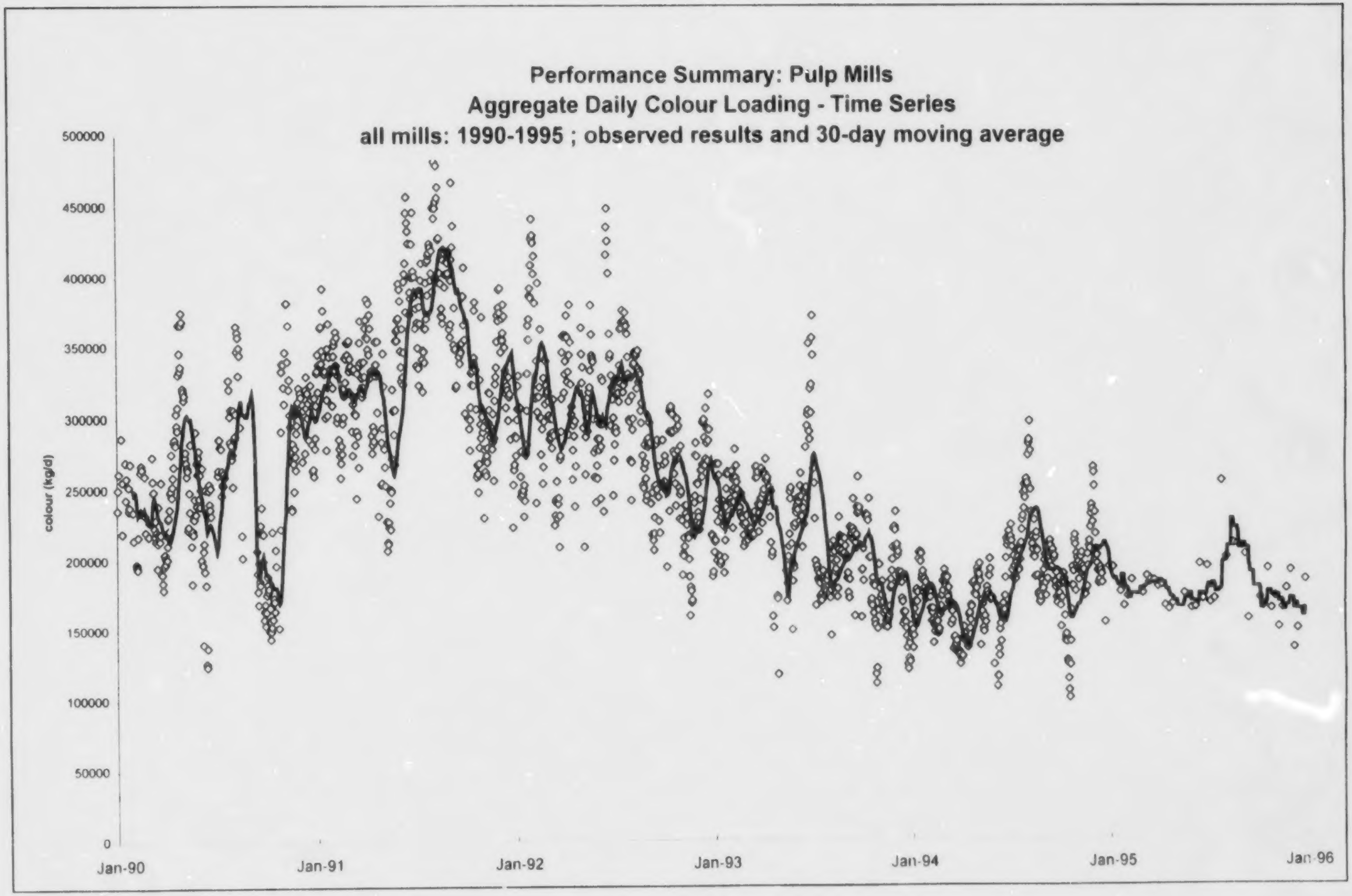
daily (kg/d)=
none

monthly (kg/d)=
none

		average daily production (ADMTD):							**aggregate production:** *all plants:*		*COD-reporting plants only:*	
		Weldwood	**ANC**	**Millar Western**	**Slave Lake**	**Al-Pac**	**Weyerhaeuser**	**Daishowa**	**to Athabasca**	**to all**	**to Athabasca**	**to all**
average for:	**1990**	713.6	337.4	576.3	-		774.4	497.1	1627.3	2898.8	576.3	1350.7
	1991	982.7	493.2	606.3	212.7		847.3	809.3	2294.8	3951.4	212.7	1060.0
	1992	1045.4	587.6	608.3	322.2		852.8	1002.5	2563.5	4418.8	322.2	1175.0
	1993	1046.7	614.0	532.3	325.9	866.1	836.8	1048.8	3385.0	5270.6	1192.0	2028.8
	1994	1082.3	634.0	692.2	365.2	1332.7	864.3	1034.6	4106.5	6005.4	2390.1	3254.4
	1995	1101.2	655.4	679.3	344.7	1473.4	847.8	1121.6	4254.1	6223.5	2497.5	3345.3
	1990-1995	998.7	581.4	615.8	315.9	1317.3	838.4	963.5	3829.1	5631.0	2249.0	3087.4

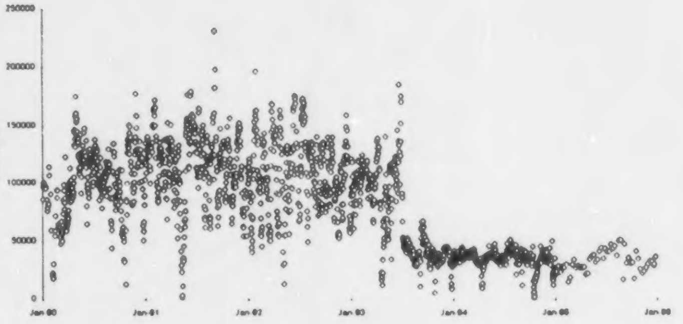
		average daily production-based COD loading (kg COD/ADMT produced):							**ratio of aggregates:** *all plants:*		*COD-reporting plants only:*	
		Weldwood	**ANC**	**Millar Western**	**Slave Lake**	**Al-Pac**	**Weyerhaeuser**	**Daishowa**	**to Athabasca**	**to all**	**to Athabasca**	**to all**
average for:	**1990**	-	-	26.52	-		52.62	-	12.0	20.8	33.8	44.6
	1991	-	-	-	43.05		63.95	-	4.0	16.0	43.1	59.8
	1992	-	-	-	26.85		59.31	-	3.4	13.4	26.9	50.4
	1993	-	-	-	26.18	13.56	48.56	-	6.0	11.2	17.0	29.2
	1994	-	-	23.64	16.31	5.85	41.46	-	7.3	11.0	12.6	20.3
	1995	10.40	-	19.10	18.29	5.64	44.42	-	9.2	12.3	15.6	22.9
	1990-1995	11.46	-	22.59	24.14	6.59	51.40	-	10.9	15.1	18.5	27.5

Colour

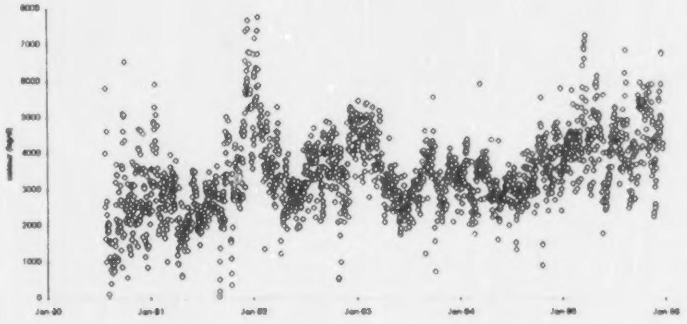


Performance Summary: Pulp Mills
Aggregate Daily Colour Loading - Time Series
all mills: 1990-1995 ; observed results and 30-day moving average

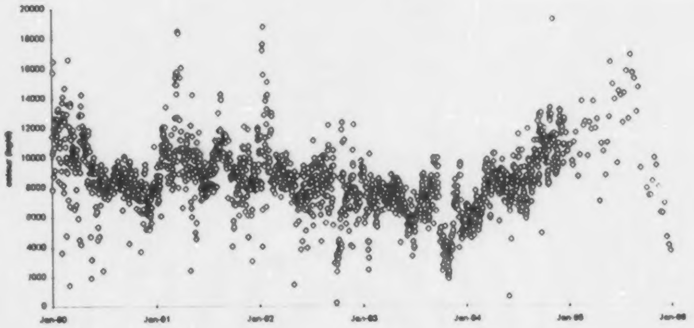
Performance Summary: Pulp Mills
Individual Daily Colour Loading - Time Series
Weldwood: 1990-1995



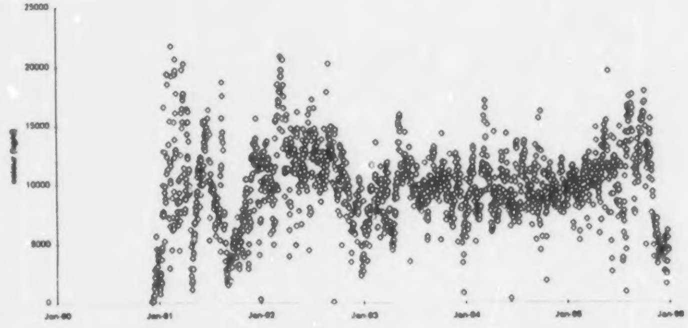
Performance Summary: Pulp Mills
Individual Daily Colour Loading - Time Series
Alberta Newsprint Company: 1990-1995

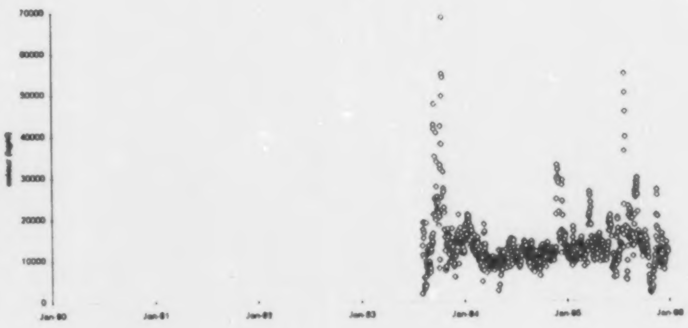


Performance Summary: Pulp Mills
Individual Daily Colour Loading - Time Series
Millar Western: 1990-1995

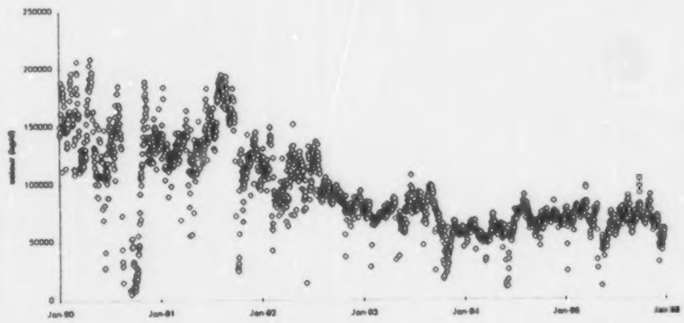


Performance Summary: Pulp Mills
Individual Daily Colour Loading - Time Series
Slave Lake Pulp Corporation: 1990-1995

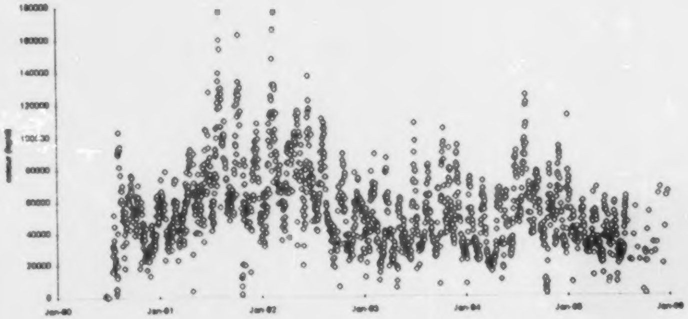




Performance Summary: Pulp Mills
Individual Daily Colour Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1995

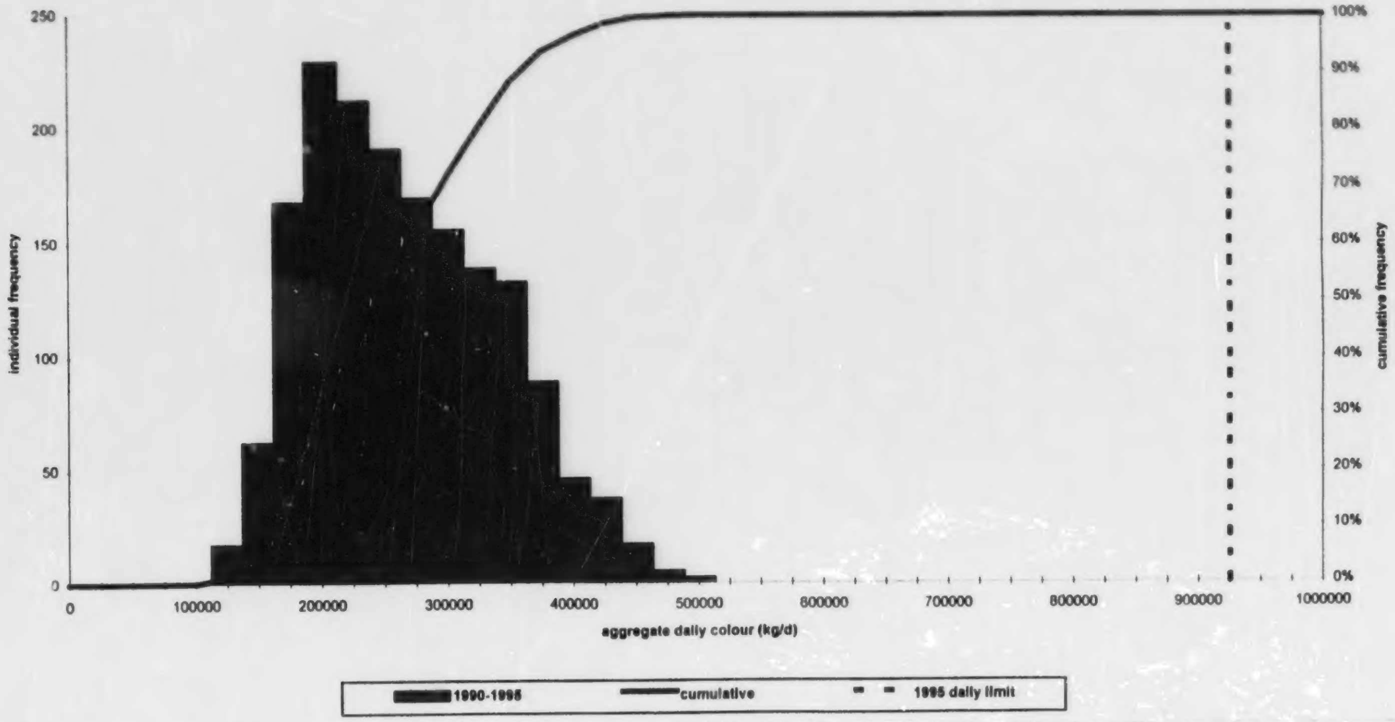


Performance Summary: Pulp Mills
Individual Daily Colour Loading - Time Series
Weyerhaeuser: 1990-1995

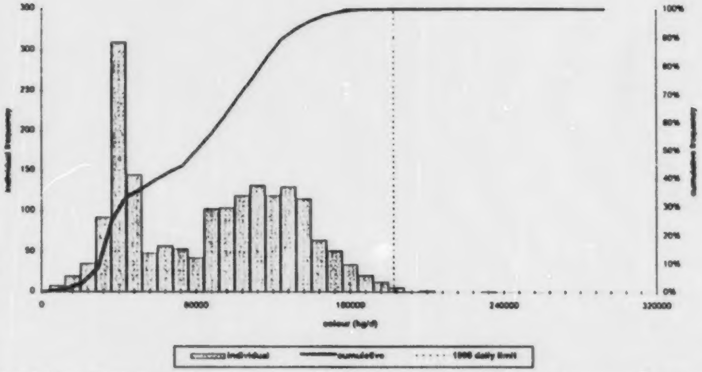


Performance Summary: Pulp Mills
Individual Daily Colour Loading - Time Series
Daishowa: 1990-1995

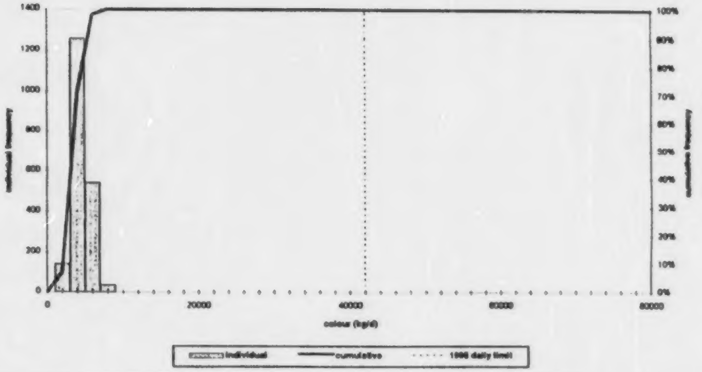
Performance Summary: Pulp Mills
Aggregate Daily Colour Loading - Frequency Distribution
all mills: 1990-1995



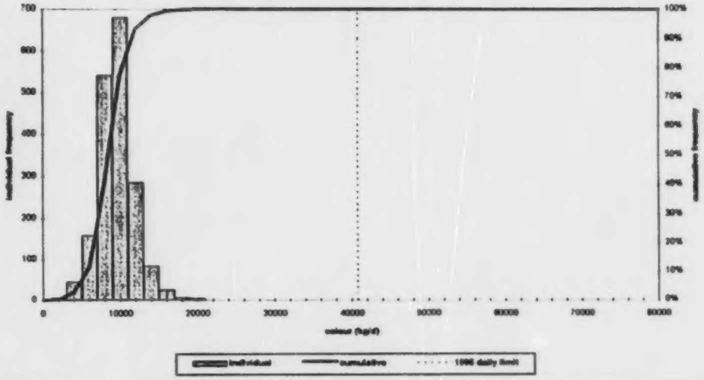
Performance Summary: Pulp Mills
Individual Daily Colour Loading - Frequency Distribution
Weldwood: 1990-1996



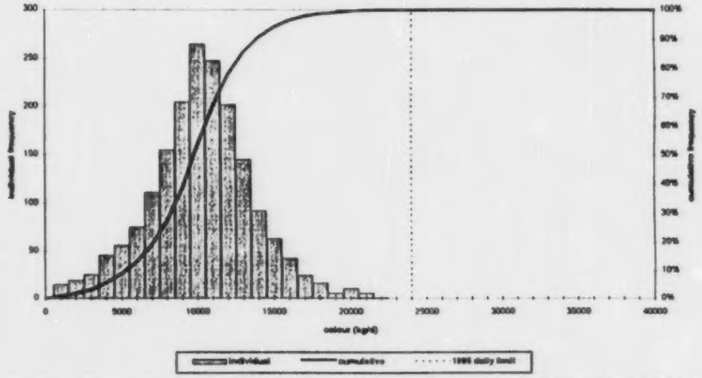
Performance Summary: Pulp Mills
Individual Daily Colour Loading - Frequency Distribution
Alberta Newsprint Company: 1990-1996



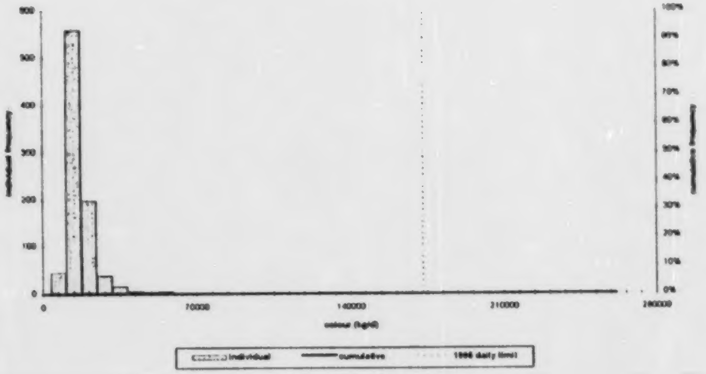
Performance Summary: Pulp Mills
Individual Daily Colour Loading - Frequency Distribution
Millar Western: 1990-1996



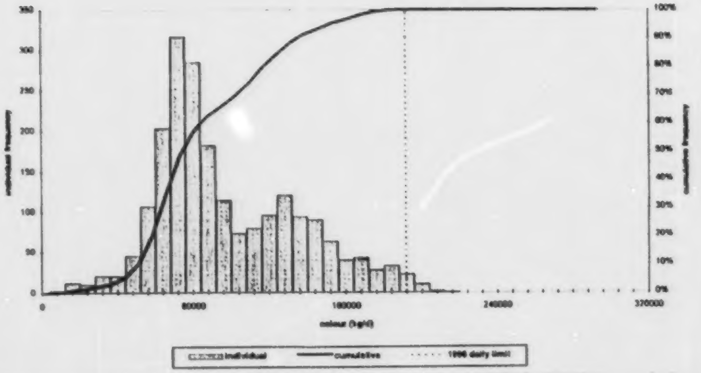
Performance Summary: Pulp Mills
Individual Daily Colour Loading - Frequency Distribution
Slave Lake Pulp Corporation: 1990-1996



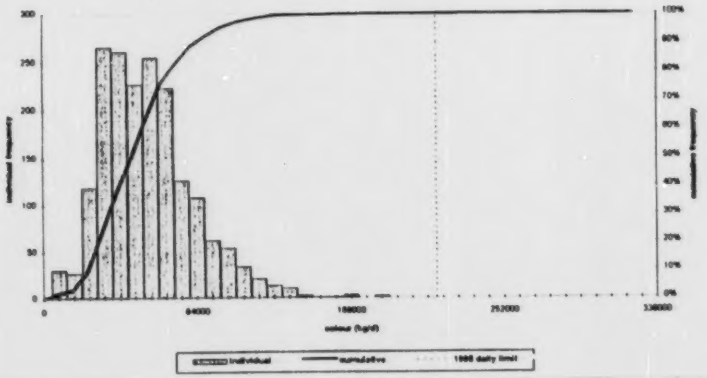
Performance Summary: Pulp Mills
Individual Daily Colour Loading - Frequency Distribution
Alberta-Pacific Forest Industries: 1990-1995



Performance Summary: Pulp Mills
Individual Daily Colour Loading - Frequency Distribution
Weyerhaeuser: 1990-1995



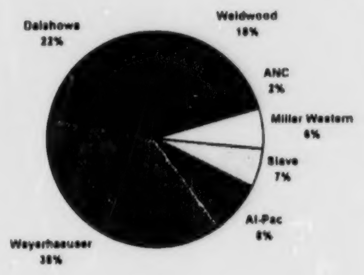
Performance Summary: Pulp Mills
Individual Daily Colour Loading - Frequency Distribution
Dalshowa: 1990-1995



Performance Summary: Pulp Mills

Average Daily Colour Loading for 1995

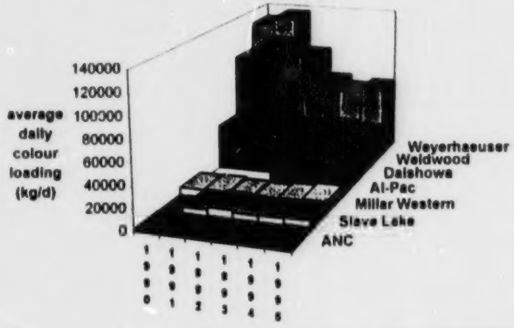
100% = 177071.6 kg/d aggregate colour loading



Performance Summary: Pulp Mills

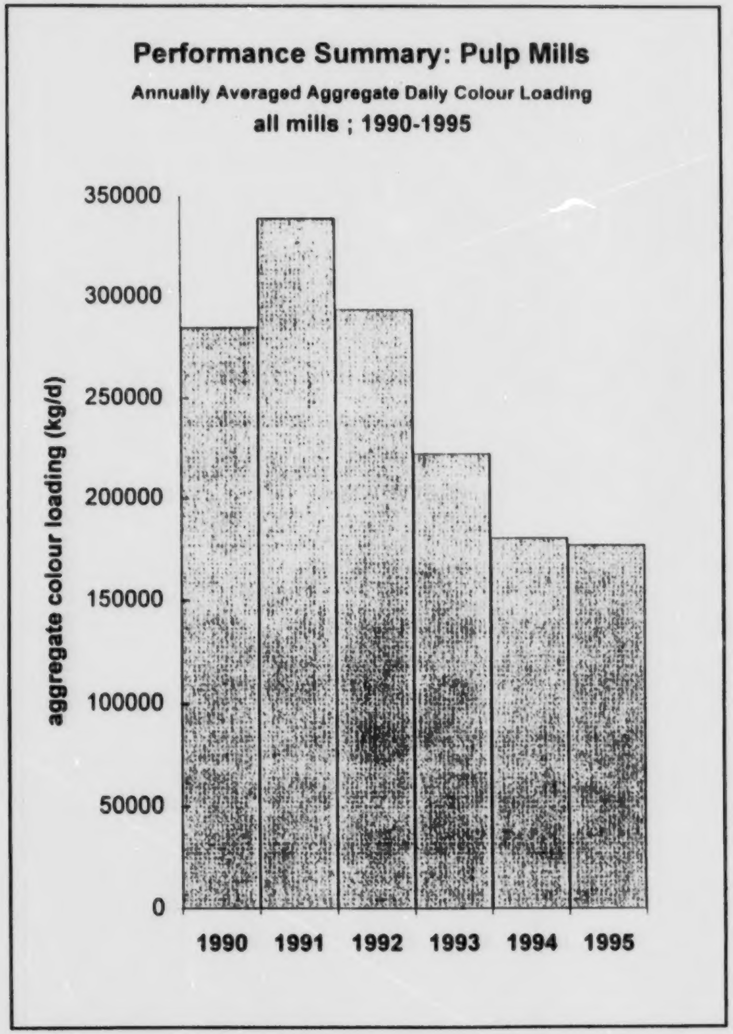
Annually Averaged Daily Colour Loading

all mills ; 1990-1995

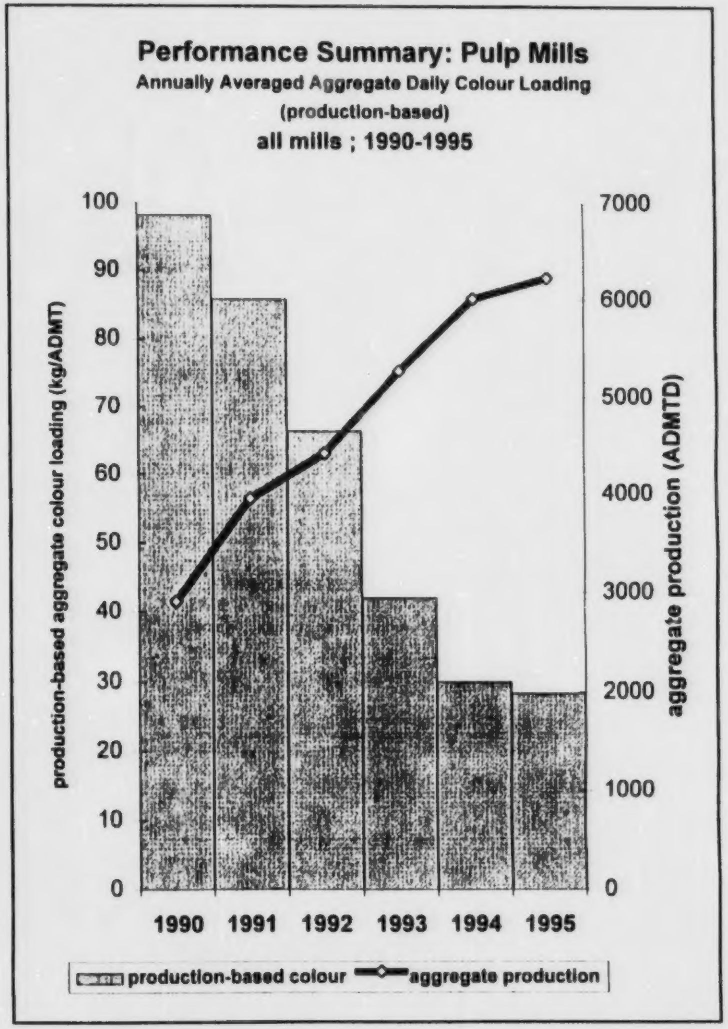


colour: *calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995*

mill	1990 x (kg/d)	s (kg/d)	1991 x (kg/d)	s (kg/d)	1992 x (kg/d)	s (kg/d)	1993 x (kg/d)	s (kg/d)	1994 x (kg/d)	s (kg/d)	1995 x (kg/d)	s (kg/d)	1995 imposed limits (kg/d): daily	monthly
Weldwood	101792.7	28043.4	115871.4	31490.0	107636.8	32473.6	69201.1	36970.2	34842.8	7242.5	31813.9	8477.1	200000	154000
ANC	2485.2	1133.0	3007.6	1217.0	3635.9	1036.4	3415.9	828.1	3270.4	672.0	4367.0	949.3	42000	31500
Millar Western	8961.9	2200.0	9485.5	2003.4	8313.7	2248.6	6637.4	1615.8	8729.2	2122.4	10970.5	3226.2	40800	30600
Slave Lake	2012.0	1629.7	8915.9	4311.6	11162.0	3367.5	9266.3	2341.2	9606.4	2138.8	10205.2	3505.7	24000	18000
Al-Pac							16894.9	10849.1	12132.4	4145.7	13566.7	6095.9	185500	104000
Weyerhaeuser	127106.4	45161.9	134350.2	28544.8	97223.6	18654.9	70676.6	15348.0	63566.0	10858.3	67765.9	11897.8	209700	114800
Dalshowa	42403.4	21482.6	67470.3	26998.0	65522.1	26982.5	45609.1	19552.6	48351.4	21886.9	38392.4	14574.3	224000	182000



Performance Summary: Pulp Mills
Annually Averaged Aggregate Daily Colour Loading
all mills ; 1990-1995



Performance Summary: Pulp Mills
Annually Averaged Aggregate Daily Colour Loading
(production-based)
all mills ; 1990-1995

Pulp Mills: production based summary of colour loading
all mills ; 1990-1995

		average daily colour loading (kg/d):							*aggregate:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa	to Athabasca	to all
total samples 1990-1995:		1834	1981	1843	1838	876	2124	1849		
average for:	1990	101792.7	2485.2	8961.9	2012.0		127106.4	42403.4	115251.7	284761.5
	1991	115871.4	3007.6	9485.5	8915.9		134350.2	67470.3	137280.4	339100.9
	1992	107636.8	3635.9	8313.7	11152.0		97223.6	65522.1	130738.3	293484.1
	1993	69201.1	3415.9	6637.4	9266.3	16894.9	70676.6	45809.1	105415.7	221901.4
	1994	34842.8	3270.4	8729.2	9606.4	12132.4	63566.0	48351.4	68581.2	180498.6
	1995	31813.9	4367.0	10970.5	10205.2	13566.7	67755.9	38392.4	70923.3	177071.6
	1990-1995	83636.5	3456.7	8496.8	9727.7	13531.4	93324.5	53048.7	118849.1	265222.3

aggregate limits for 1995:

daily (kg/d)=
925400

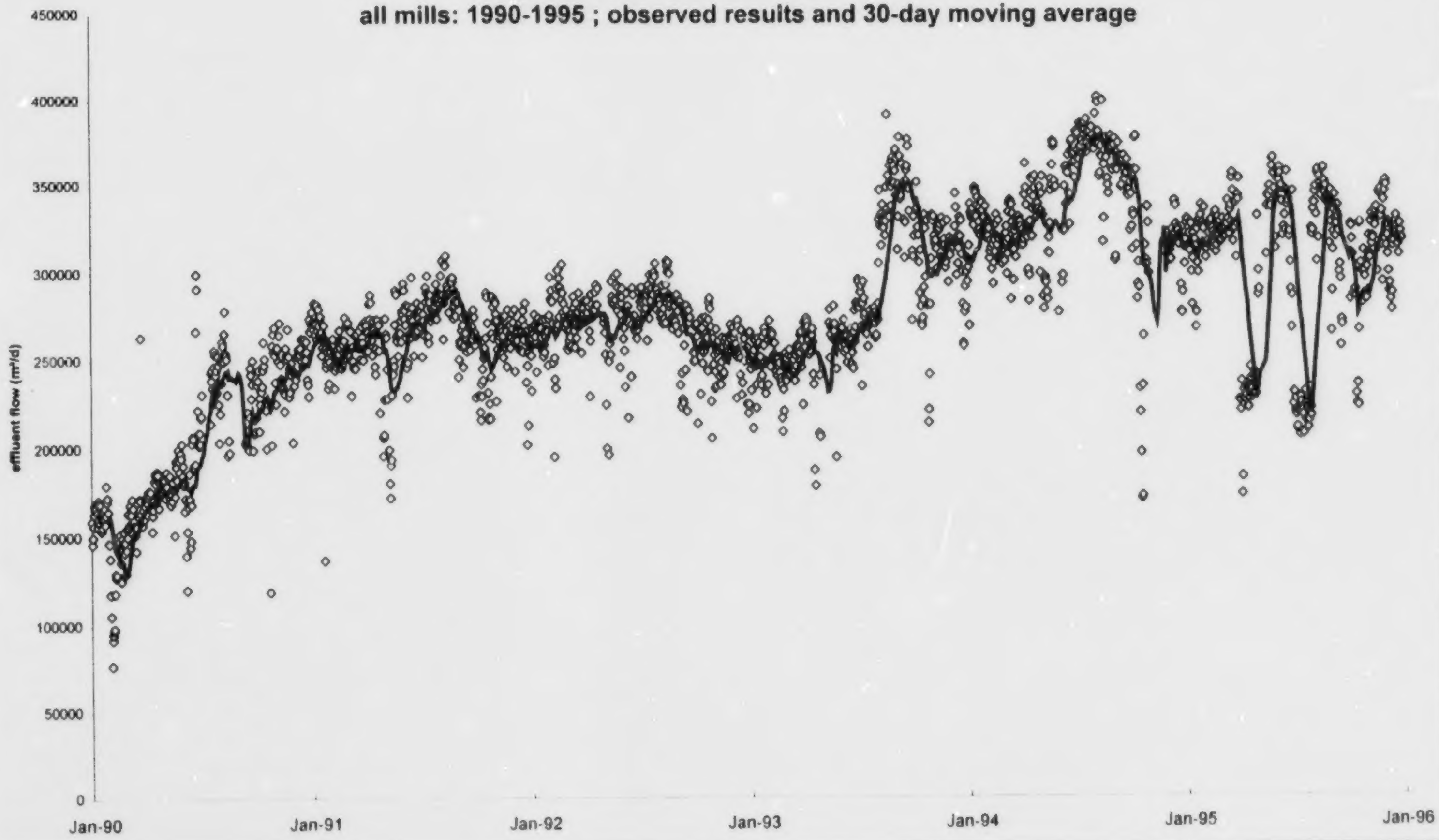
monthly (ADMTD) (kg/d)=
634900

		average daily production (ADMTD):							aggregate production: *all plants:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa	to Athabasca	to all
average for:	1990	713.6	337.4	576.3	-		774.4	497.1	1627.3	2898.8
	1991	982.7	493.2	606.3	212.7		847.3	809.3	2294.9	3951.4
	1992	1045.4	587.6	608.3	322.2		852.8	1002.5	2563.5	4418.8
	1993	1046.7	614.0	532.3	325.9	866.1	836.8	1048.8	3385.0	5270.6
	1994	1082.3	634.0	692.2	365.2	1332.7	864.3	1034.6	4106.5	6005.4
	1995	1101.2	655.4	679.3	344.7	1473.4	847.8	1121.6	4254.1	6223.5
	1990-1995	998.7	581.4	615.8	315.9	1317.3	838.4	963.5	3829.1	5631.0

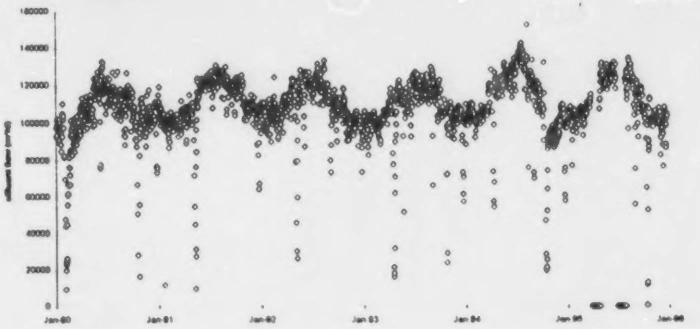
		average daily production-based colour loading (kg colour/ADMT produced):							*ratio of aggregates:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa	to Athabasca	to all
average for:	1990	142.65	7.37	15.55	-		164.13	85.31	70.83	98.24
	1991	117.92	6.10	15.65	41.91		158.56	83.37	59.82	85.82
	1992	102.97	6.19	13.67	34.61		114.00	65.36	51.00	66.42
	1993	66.11	5.56	12.47	28.43	19.51	84.46	43.68	31.14	42.10
	1994	32.19	5.16	12.61	26.31	9.10	73.55	46.73	16.70	30.06
	1995	28.89	6.66	16.15	29.60	9.21	79.92	34.23	16.67	28.45
	1990-1995	83.75	5.95	13.80	30.80	10.27	111.31	55.06	31.04	47.10

Effluent Flow

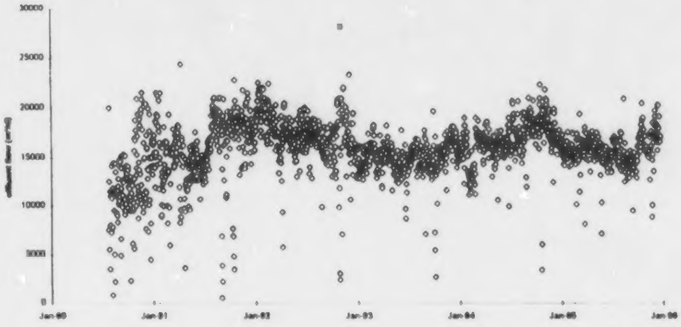
Performance Summary: Pulp Mills
Aggregate Daily Effluent Flow - Time Series
all mills: 1990-1995 ; observed results and 30-day moving average



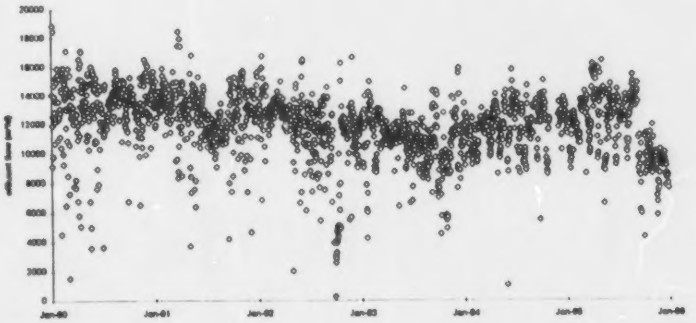
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Time Series
Weldwood: 1990-1995



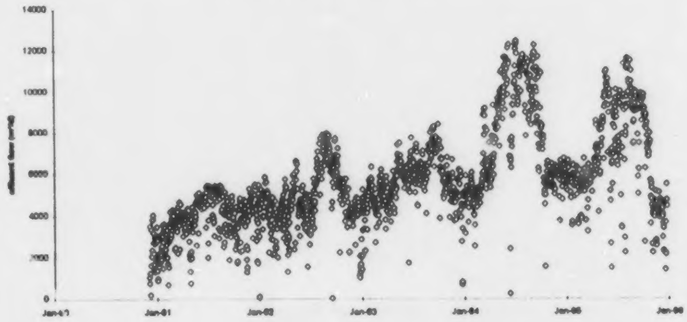
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Time Series
Alberta Newsprint Company: 1990-1995



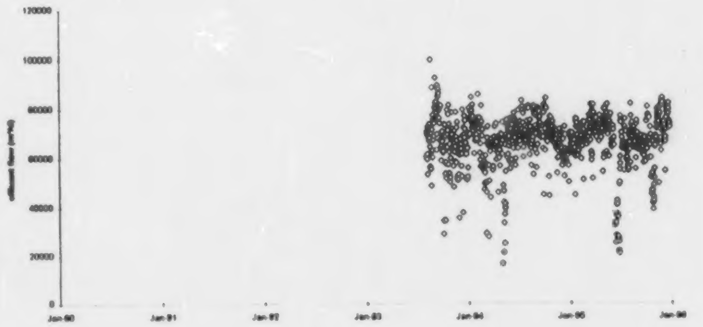
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Time Series
Millar Western: 1990-1995



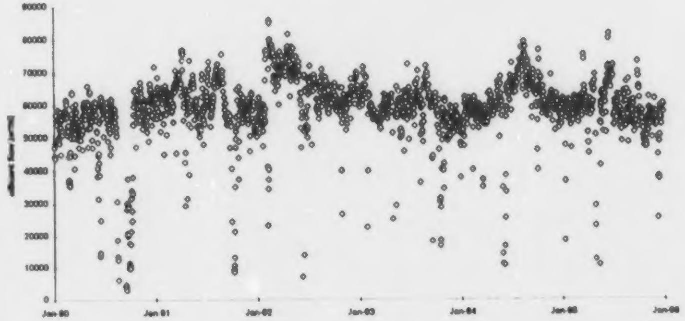
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Time Series
Slave Lake Pulp Corporation: 1990-1995



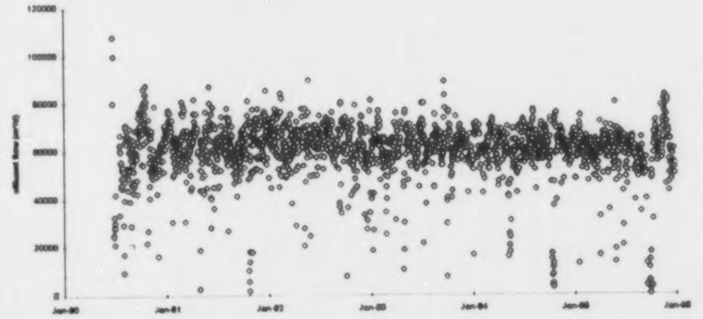
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Time Series
Alberta-Pacific Forest Industries: 1993-1995



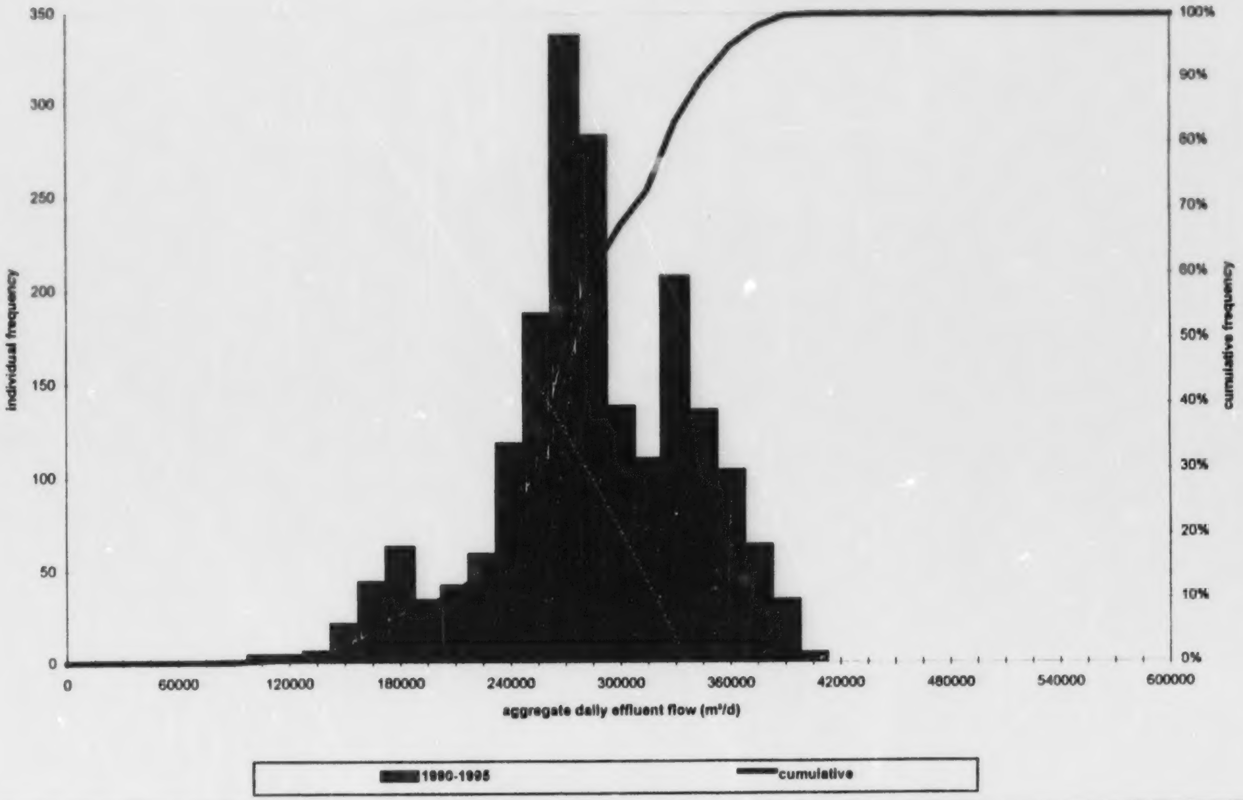
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Time Series
Weyerhaeuser: 1990-1995



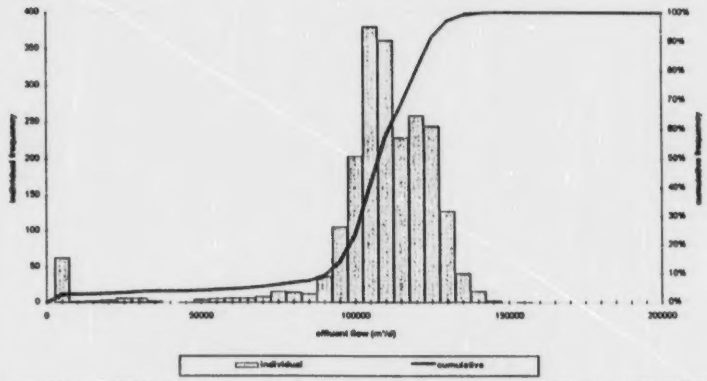
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Time Series
Daishowa: 1990-1995



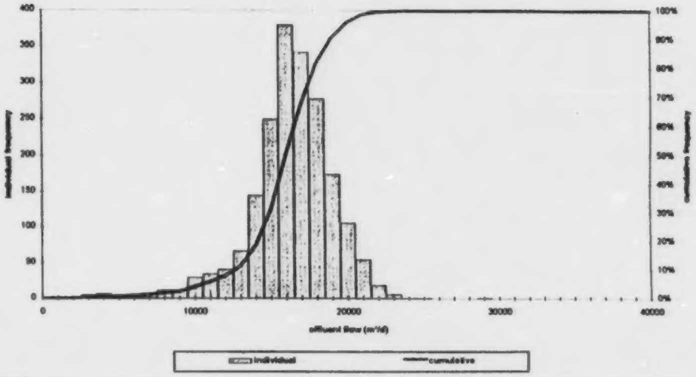
Performance Summary: Pulp Mills
Aggregate Daily Effluent Flow - Frequency Distribution
all mills: 1990-1995



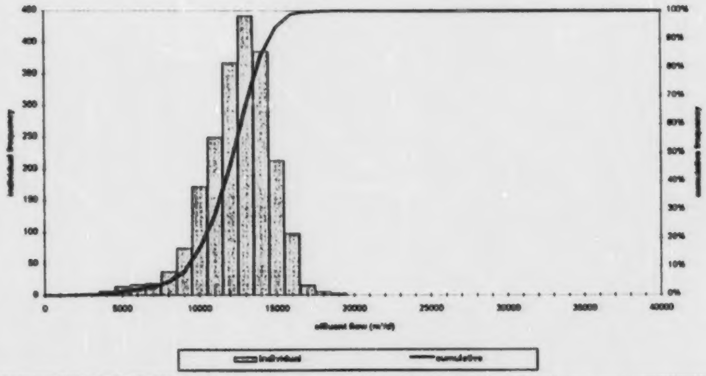
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Frequency Distribution
Weldwood: 1990-1995



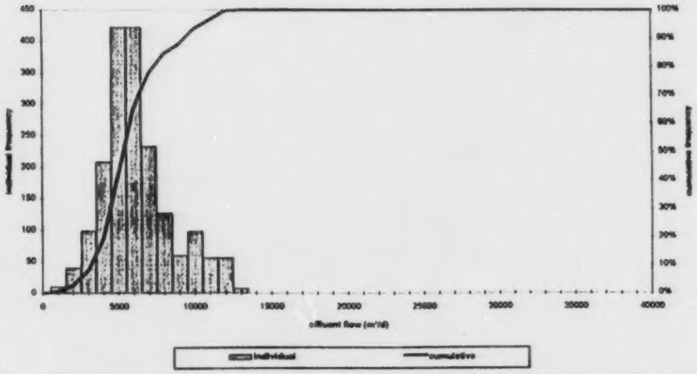
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Frequency Distribution
Alberta Newsprint Company: 1990-1995



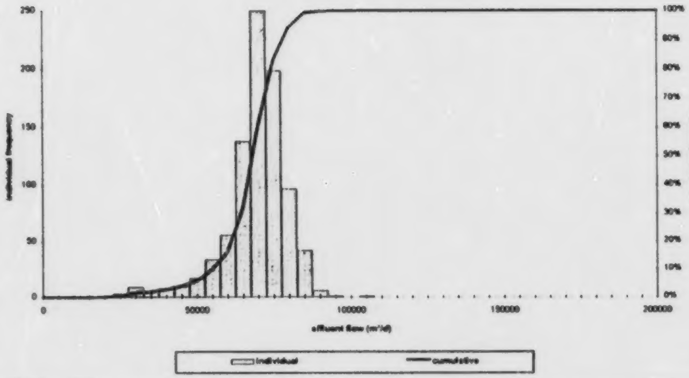
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Frequency Distribution
Millar Western: 1990-1995



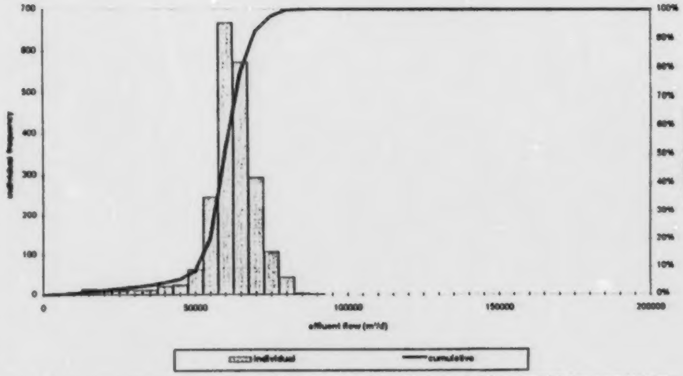
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Frequency Distribution
Slave Lake Pulp Corporation: 1990-1995



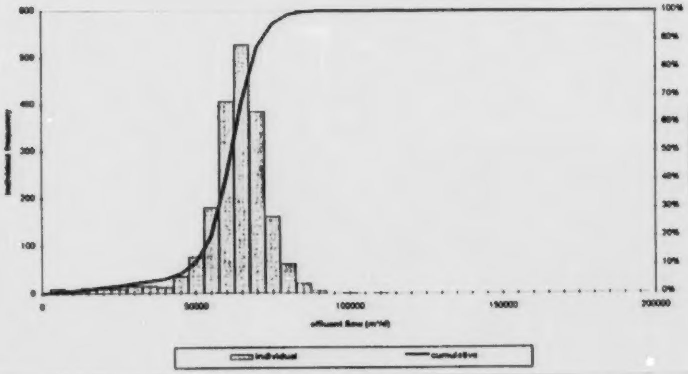
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Frequency Distribution
Alberta-Pacific Forest Industries: 1990-1995



Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Frequency Distribution
Weyerhaeuser: 1990-1995



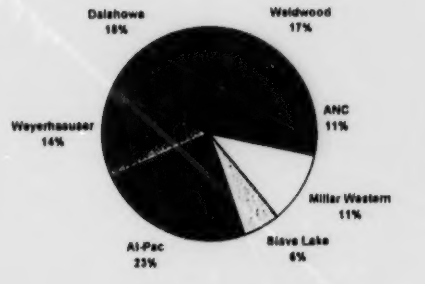
Performance Summary: Pulp Mills
Individual Daily Effluent Flow - Frequency Distribution
Daishowa: 1990-1995



Performance Summary: Pulp Mills

Average Daily Effluent Flow for 1995

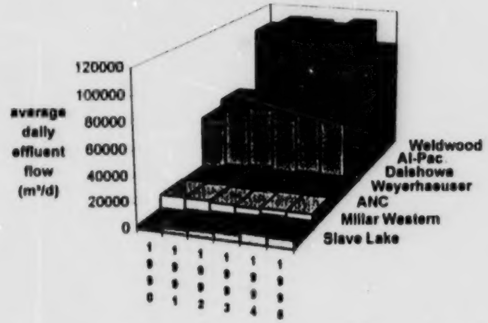
100% = 307271.2 m³/d aggregate effluent flow



Performance Summary: Pulp Mills

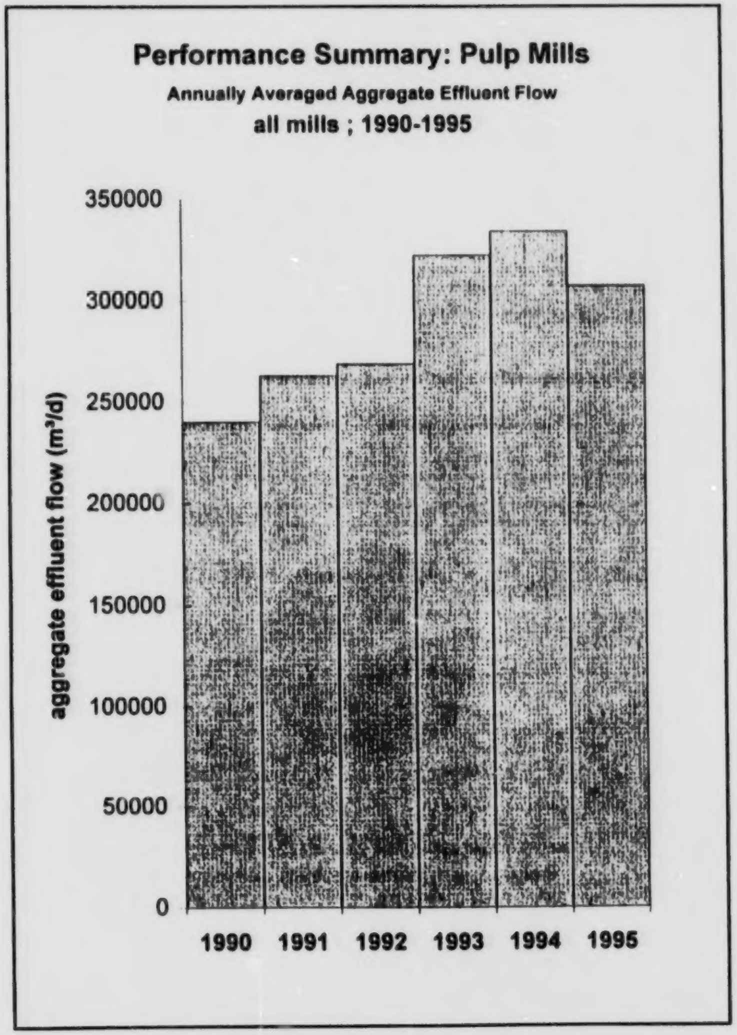
Annually Averaged Daily Effluent Flow

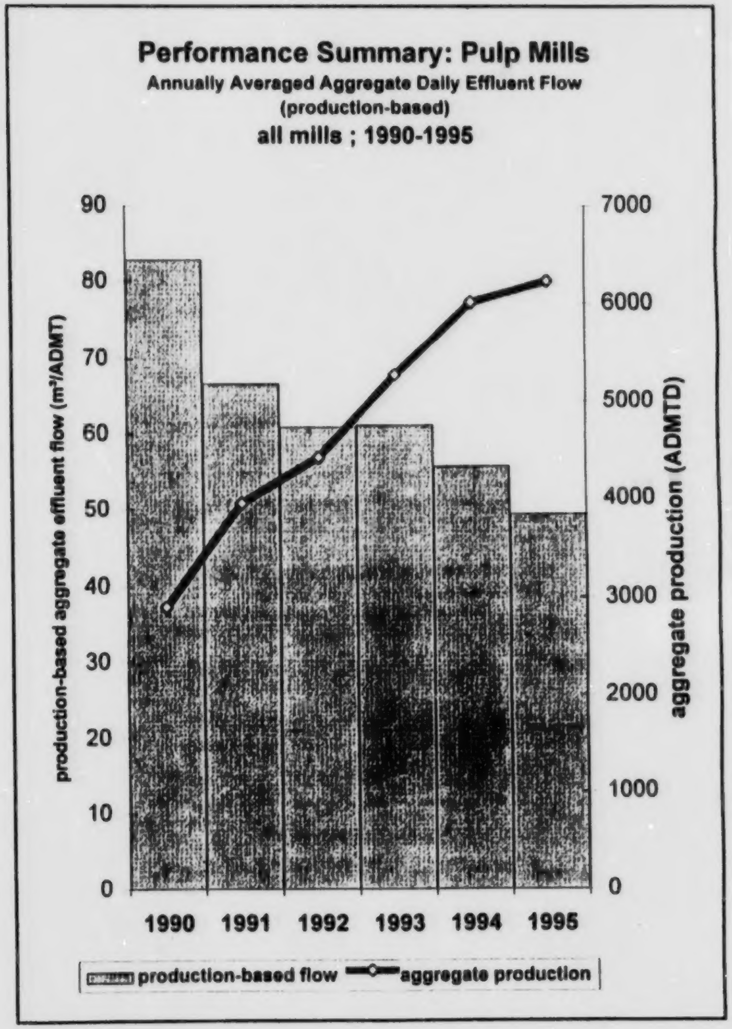
all mills ; 1990-1995



effluent flow: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (m³/d):	
mill	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	daily	monthly
Weldwood	102456.1	18256.6	109887.9	15126.7	108443.3	12811.6	105840.9	15620.9	110354.5	19264.1	90405.8	43488.5	n/a	n/a
ANC	12395.2	3889.3	15896.5	3481.5	17301.6	2584.6	14929.4	1718.0	16704.9	2203.7	16721.2	1637.5	n/a	n/a
Millar Western	13124.6	2261.7	12684.1	1960.2	11555.5	2528.5	10844.5	1839.2	11899.4	1676.5	11694.2	2200.3	n/a	n/a
Slave Lake	2374.0	1027.6	3882.0	1047.1	4756.0	1409.8	5597.7	1186.1	7692.3	2490.3	6863.4	2297.4	n/a	n/a
Al-Pac							66900.0	11232.3	66996.9	9708.8	66812.9	10579.9	n/a	n/a
Weyerhaeuser	52094.6	12867.8	59877.3	9405.2	64529.1	8896.6	57733.4	7753.8	61038.2	8538.3	58073.3	7823.6	n/a	n/a
Daishowa	57847.2	15120.5	61427.2	11646.0	62563.5	10213.0	60601.9	9953.3	59717.8	11762.5	57700.3	13136.8	n/a	n/a


Performance Summary: Pulp Mills
Annually Averaged Aggregate Effluent Flow
all mills ; 1990-1995
aggregate effluent flow (m³/d)
350000
300000
250000
200000
150000
100000
50000
0
1990
1991
1992
1993
1994
1995


Performance Summary: Pulp Mills
Annually Averaged Aggregate Daily Effluent Flow
(production-based)
all mills ; 1990-1995
production-based aggregate effluent flow (m³/ADMT)
90
80
70
60
50
40
30
20
10
0
aggregate production (ADMTD)
7000
6000
5000
4000
3000
2000
1000
0
1990
1991
1992
1993
1994
1995
production-based flow
aggregate production

Pulp Mills: production-based summary of effluent flow
all mills ; 1990-1995

		average daily effluent flow (m³/d):							*aggregate:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Daishowa	to Athabasca	to all
total samples 1990-1995:		2180	1986	2130	1851	877	2126	1969		
average for:	1990	102456.1	12395.2	13124.6	2374.0		52094.6	57847.2	130349.9	240291.6
	1991	109687.9	15698.5	12684.1	3882.0		59877.3	61427.2	141952.7	263257.1
	1992	108443.3	17301.6	11555.5	4756.0		64529.1	62563.5	142056.3	269148.9
	1993	105840.9	14929.4	10844.5	5597.7	66900.0	57733.4	60601.9	204112.5	322447.8
	1994	110354.5	16704.9	11899.4	7692.3	66996.9	61038.2	59717.6	213648.0	334404.0
	1995	90405.6	15721.2	11694.2	6863.4	66812.9	58073.3	57700.3	191497.5	307271.2
	1990-1995	104525.7	15775.6	11971.3	5707.2	66904.3	58967.8	60174.6	204884.1	324026.4

aggregate limits for 1995:

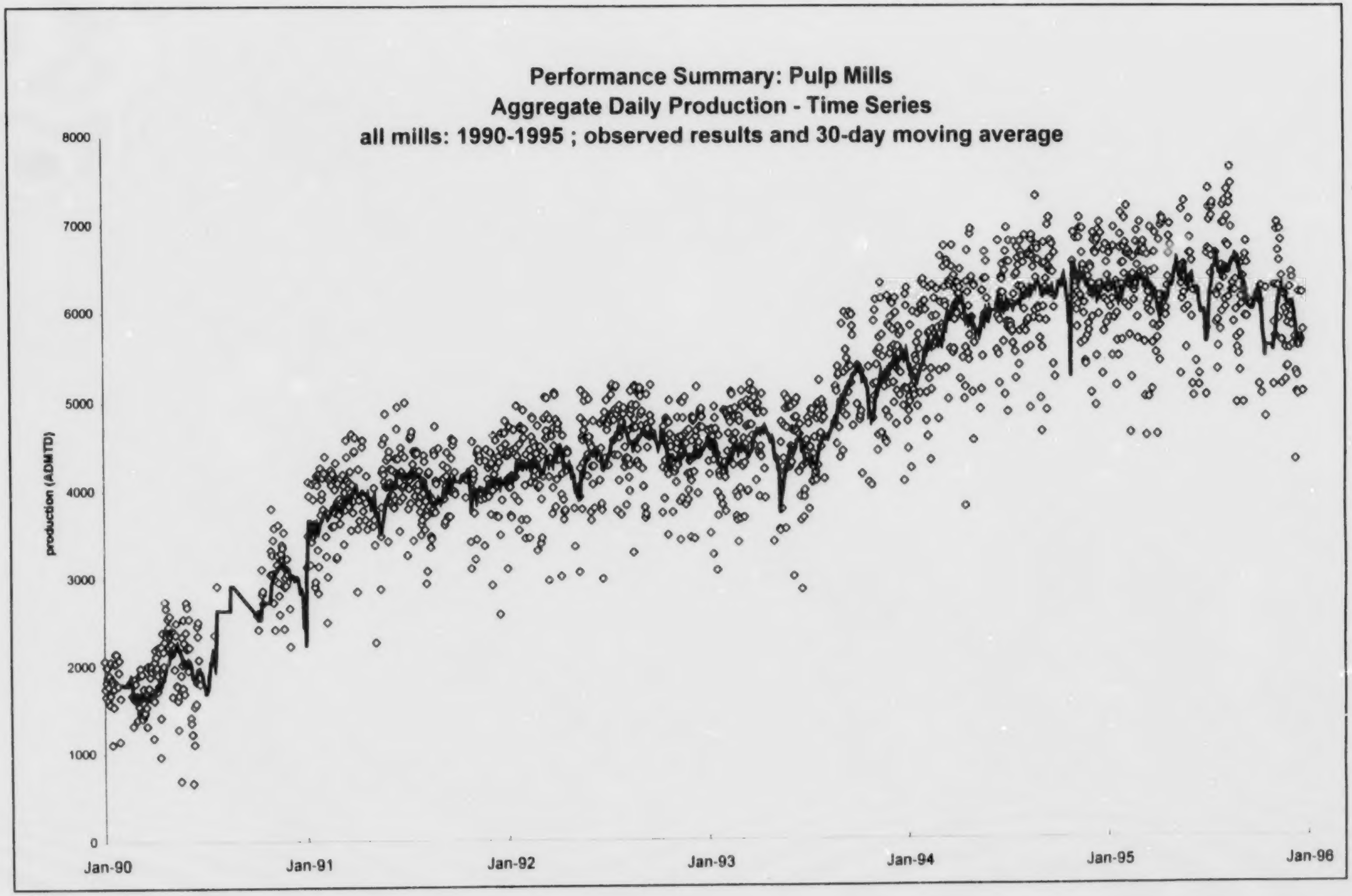
daily (m³/d) =
n/a

monthly (m³/d) =
n/a

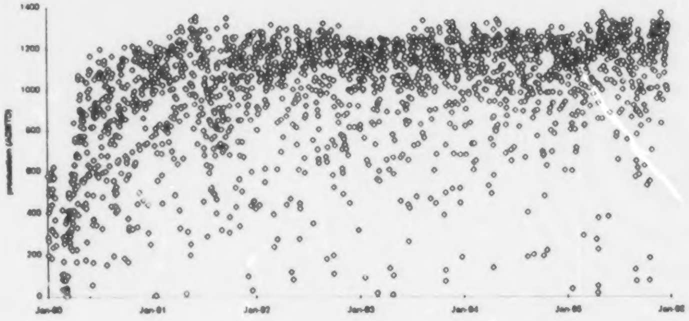
		average daily production (ADMTD):							aggregate production: *all plants:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Daishowa	to Athabasca	to all
average for:	1990	713.6	337.4	576.3	-		774.4	497.1	1627.3	2898.8
	1991	982.7	493.2	606.3	212.7		847.3	809.3	2294.8	3951.4
	1992	1045.4	587.6	608.3	322.2		852.8	1002.5	2563.6	4418.8
	1993	1046.7	614.0	532.3	325.9	866.1	836.8	1048.8	3385.0	5270.6
	1994	1082.3	634.0	692.2	365.2	1332.7	864.3	1034.6	4106.5	6005.4
	1995	1101.2	655.4	679.3	344.7	1473.4	847.6	1121.6	4254.1	6223.5
	1990-1995	998.7	581.4	615.8	315.9	1317.3	838.4	963.5	3829.1	5631.0

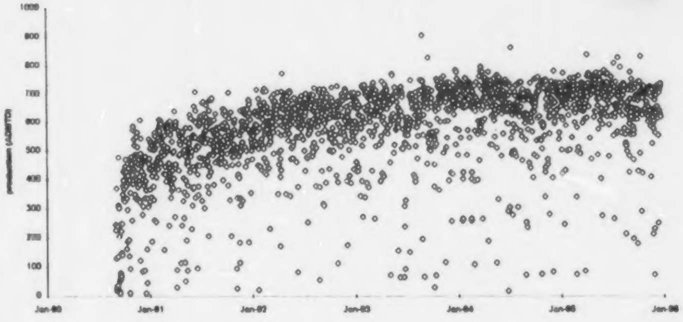
		average daily production-based effluent flow (m³ flow/ADMT produced):							*ratio of aggregates:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Daishowa	to Athabasca	to all
average for:	1990	143.58	36.74	22.77	-		67.27	116.38	80.10	82.89
	1991	111.62	31.83	20.92	18.25		70.67	75.91	61.86	66.62
	1992	103.74	29.44	19.00	14.76		75.66	62.40	55.42	60.91
	1993	101.12	24.32	20.37	17.18	77.26	68.99	57.78	60.30	61.18
	1994	101.96	26.35	17.19	21.07	50.27	70.62	57.72	52.03	55.68
	1995	82.10	23.99	17.21	19.91	45.36	68.50	51.44	45.02	49.37
	1990-1995	104.66	27.13	19.44	18.07	50.79	70.34	62.45	53.51	57.54

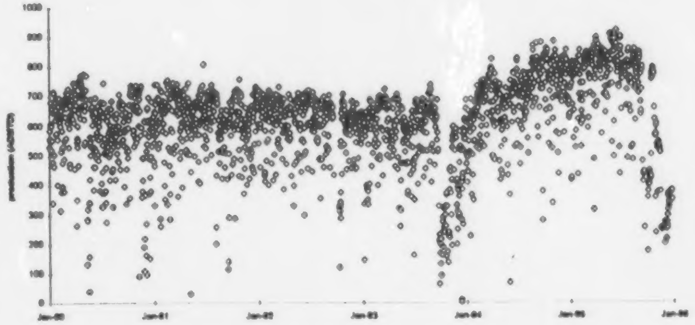
Production

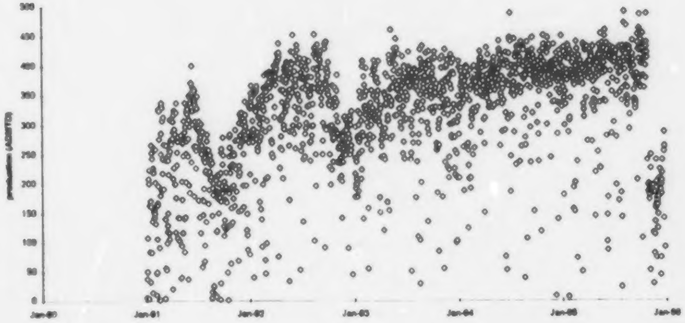


Performance Summary: Pulp Mills
Aggregate Daily Production - Time Series
all mills: 1990-1995 ; observed results and 30-day moving average

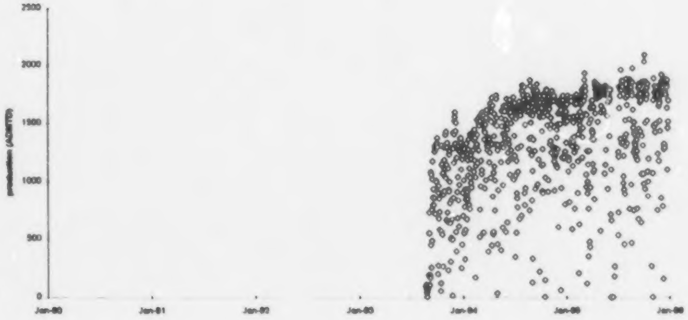

Performance Summary: Pulp Mills
Individual Daily Production - Time Series
Weldwood: 1990-1995


Performance Summary: Pulp Mills
Individual Daily Production - Time Series
Alberta Newsprint Company: 1990-1995

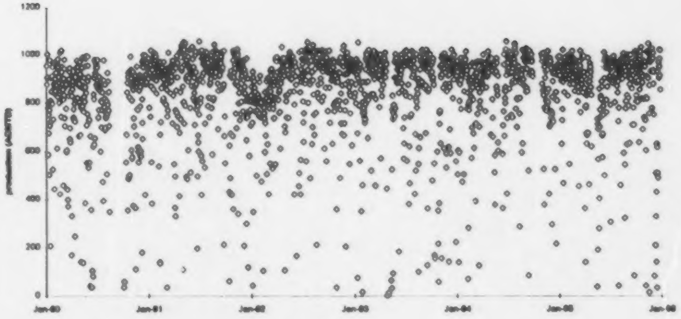

Performance Summary: Pulp Mills
Individual Daily Production - Time Series
Millar Western: 1990-1995


Performance Summary: Pulp Mills
Individual Daily Production - Time Series
Slave Lake Pulp Corporation: 1990-1995

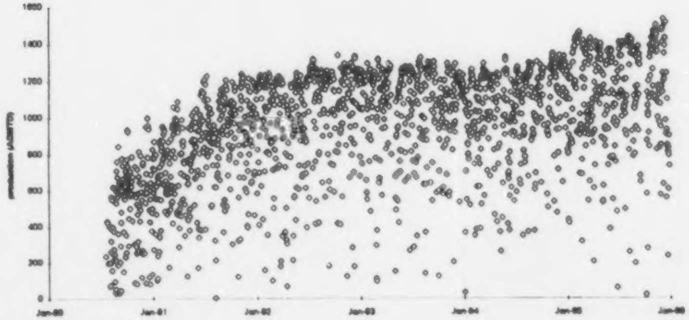
Performance Summary: Pulp Mills
Individual Daily Production - Time Series
Alberta-Pacific Forest Industries: 1993-1995



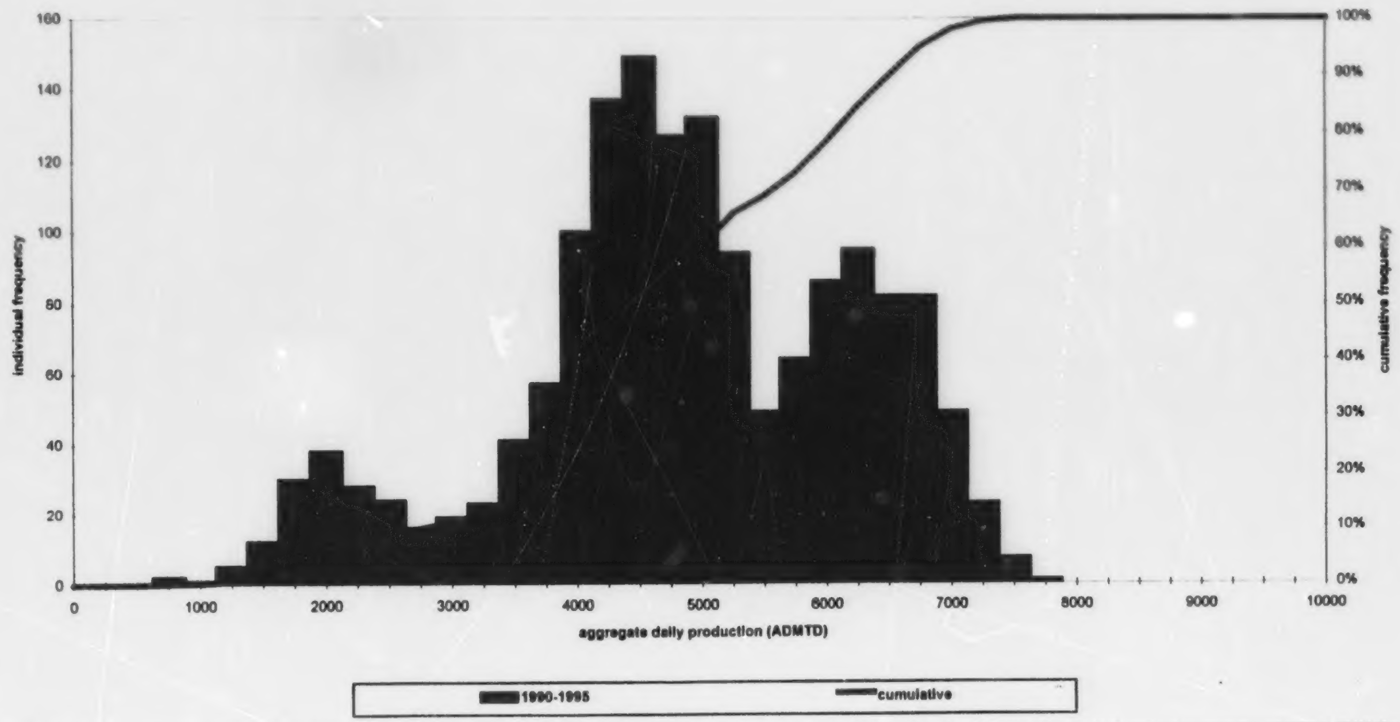
Performance Summary: Pulp Mills
Individual Daily Production - Time Series
Weyerhaeuser: 1990-1995



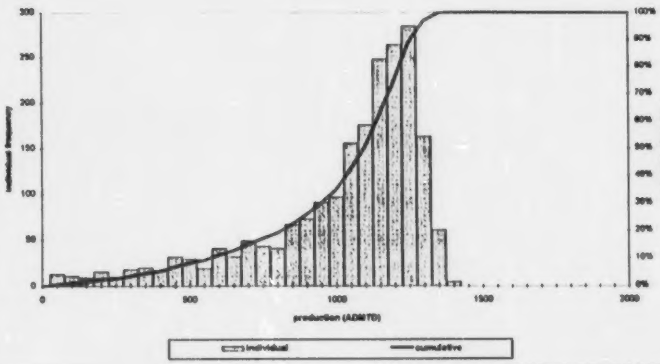
Performance Summary: Pulp Mills
Individual Daily Production - Time Series
Dalshowa: 1990-1995



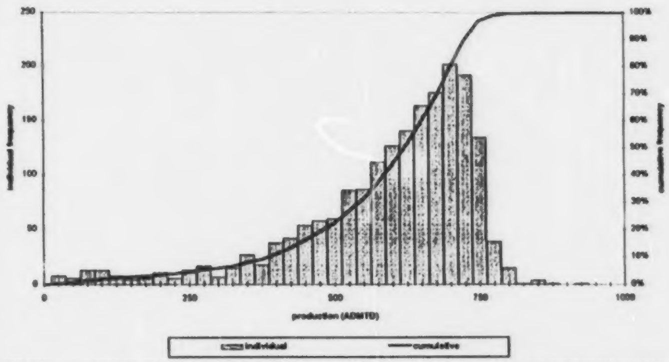
Performance Summary: Pulp Mills
Aggregate Daily Production - Frequency Distribution
all mills: 1990-1995



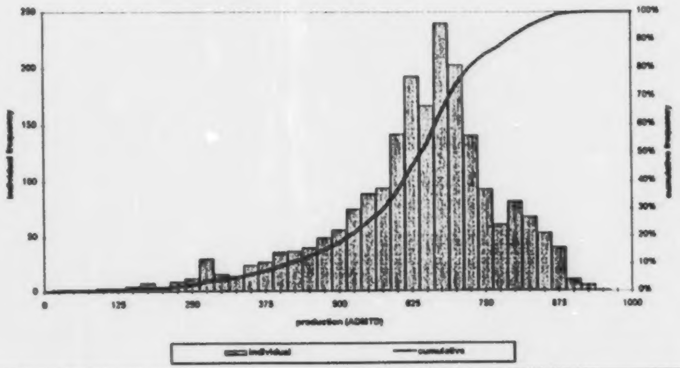
Performance Summary: Pulp Mills
Individual Daily Production - Frequency Distribution
Weldwood: 1990-1995



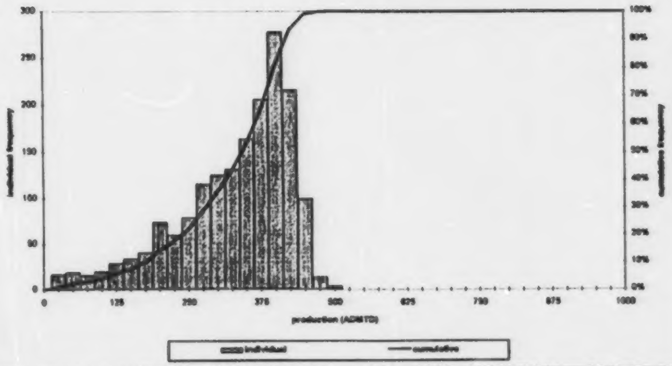
Performance Summary: Pulp Mills
Individual Daily Production - Frequency Distribution
Alberta Newsprint Company: 1990-1995



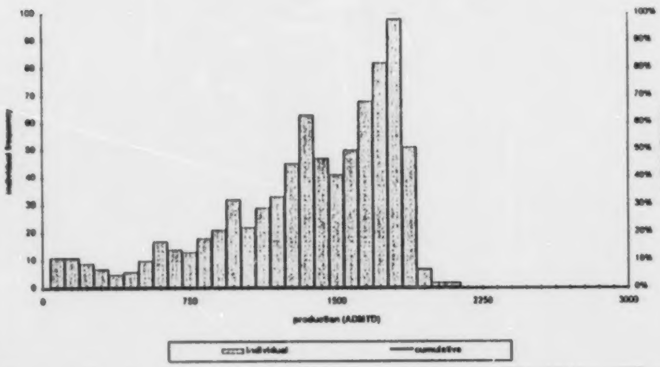
Performance Summary: Pulp Mills
Individual Daily Production - Frequency Distribution
Millar Western: 1990-1995



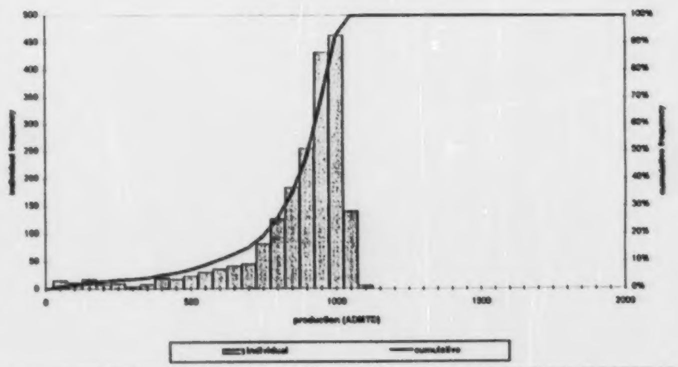
Performance Summary: Pulp Mills
Individual Daily Production - Frequency Distribution
Slave Lake Pulp Corporation: 1990-1995



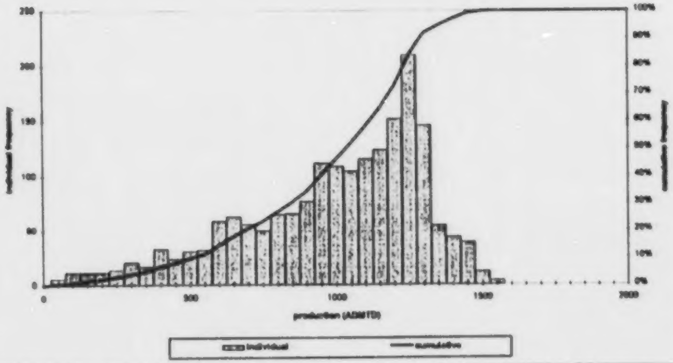
Performance Summary: Pulp Mills
Individual Daily Production - Frequency Distribution
Alberta-Pacific Forest Industries: 1990-1995



Performance Summary: Pulp Mills
Individual Daily Production - Frequency Distribution
Weyerhaeuser: 1990-1995



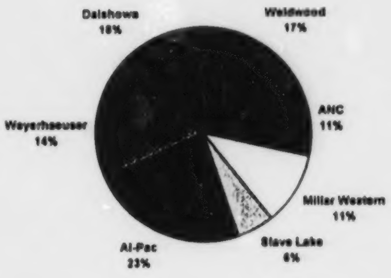
Performance Summary: Pulp Mills
Individual Daily Production - Frequency Distribution
Dalshowa: 1990-1995



Performance Summary: Pulp Mills

Average Daily Production for 1995

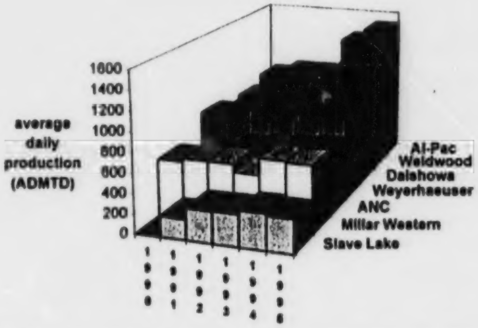
100% = 6223.5 ADMTD aggregate production



Performance Summary: Pulp Mills

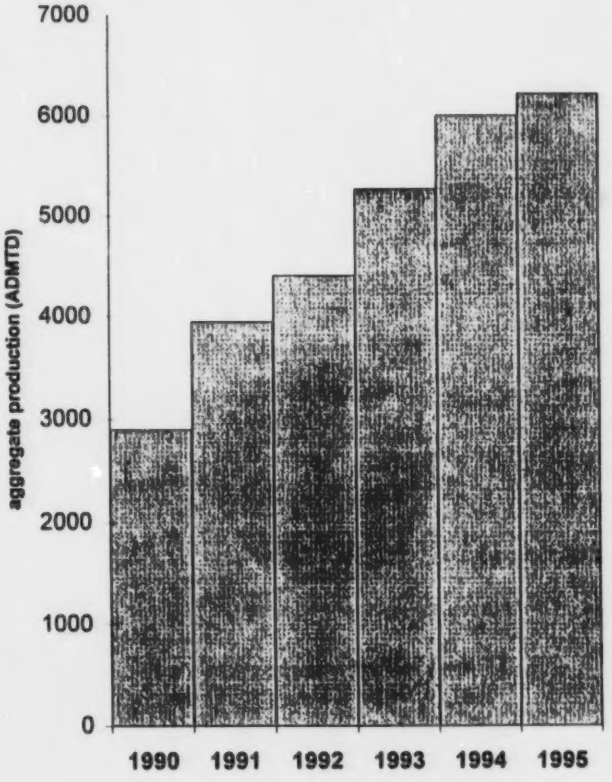
Annually Averaged Daily Production

all mills ; 1990-1995



__production:__ calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

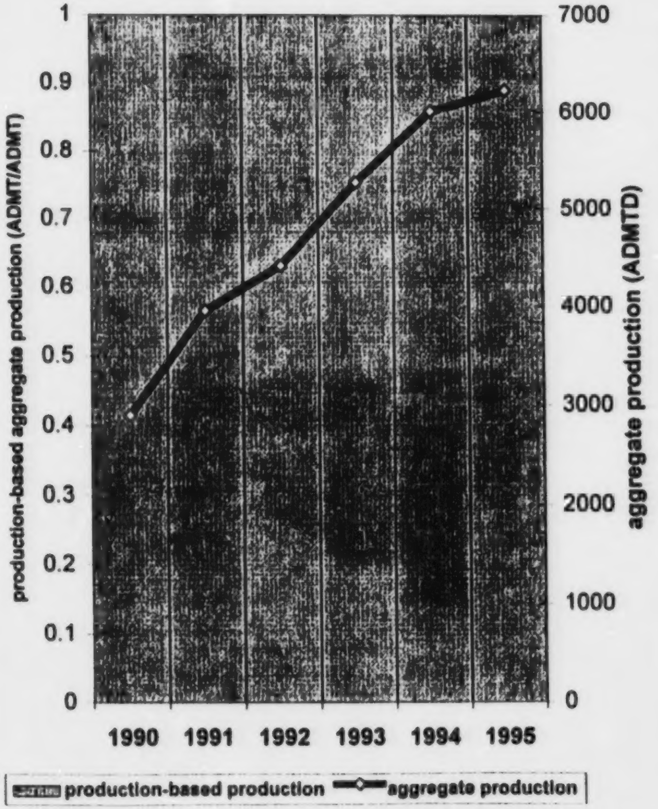
mill	1990 x (ADMTD)	1990 s (ADMTD)	1991 x (ADMTD)	1991 s (ADMTD)	1992 x (ADMTD)	1992 s (ADMTD)	1993 x (ADMTD)	1993 s (ADMTD)	1994 x (ADMTD)	1994 s (ADMTD)	1995 x (ADMTD)	1995 s (ADMTD)	1995 imposed limits (ADMTD): daily	1995 imposed limits (ADMTD): monthly
Weldwood	713.6	316.7	982.7	256.9	1045.4	242.2	1046.7	244.9	1082.3	203.0	1101.2	236.2	n/a	n/a
ANC	337.4	155.8	493.2	124.7	587.6	108.1	614.0	135.9	634.0	133.5	655.4	117.3	n/a	n/a
Millar Western	576.3	131.1	606.3	110.1	608.3	90.4	532.3	150.9	692.2	115.3	679.3	195.5	n/a	n/a
Slave Lake	-	-	212.7	88.8	322.2	78.0	325.9	75.6	365.2	67.6	344.7	104.9	n/a	n/a
Al-Pac							866.1	443.0	1332.7	383.4	1473.4	416.6	n/a	n/a
Weyerhaeuser	774.4	216.0	847.3	187.6	862.8	167.3	836.8	221.1	864.3	169.9	847.8	203.8	n/a	n/a
Dalshowa	497.1	234.2	809.3	255.7	1002.5	277.2	1048.8	255.0	1034.6	245.5	1121.6	287.6	n/a	n/a



Performance Summary: Pulp Mills

Annually Averaged Aggregate Production

all mills ; 1990-1995



Performance Summary: Pulp Mills

Annually Averaged Aggregate Daily Production

(production-based)

all mills ; 1990-1995

Pulp Mills: production-based summary of production
all mills ; 1990-1995

		average daily production (ADMTD):							*aggregate:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Daishowa	to Athabasca	to all
total samples 1990-1995:		2086	1908	2138	1745	814	2086	2086		
average for:	1990	713.6	337.4	576.3	-		774.4	497.1	1627.3	2898.8
	1991	982.7	493.2	606.3	212.7		847.3	809.3	2294.6	3951.4
	1992	1045.4	587.6	608.3	322.2		852.8	1002.6	2583.5	4418.8
	1993	1046.7	614.0	632.3	325.9	866.1	836.8	1048.8	3385.0	5270.6
	1994	1082.3	634.0	692.2	365.2	1332.7	864.3	1034.6	4106.6	6005.4
	1995	1101.2	655.4	679.3	344.7	1473.4	847.8	1121.6	4254.1	6223.5
	1990-1995	998.7	581.4	615.8	315.9	1317.3	838.4	963.5	3828.1	5631.0

aggregate limits for 1995:

daily (ADMTD) =
n/a

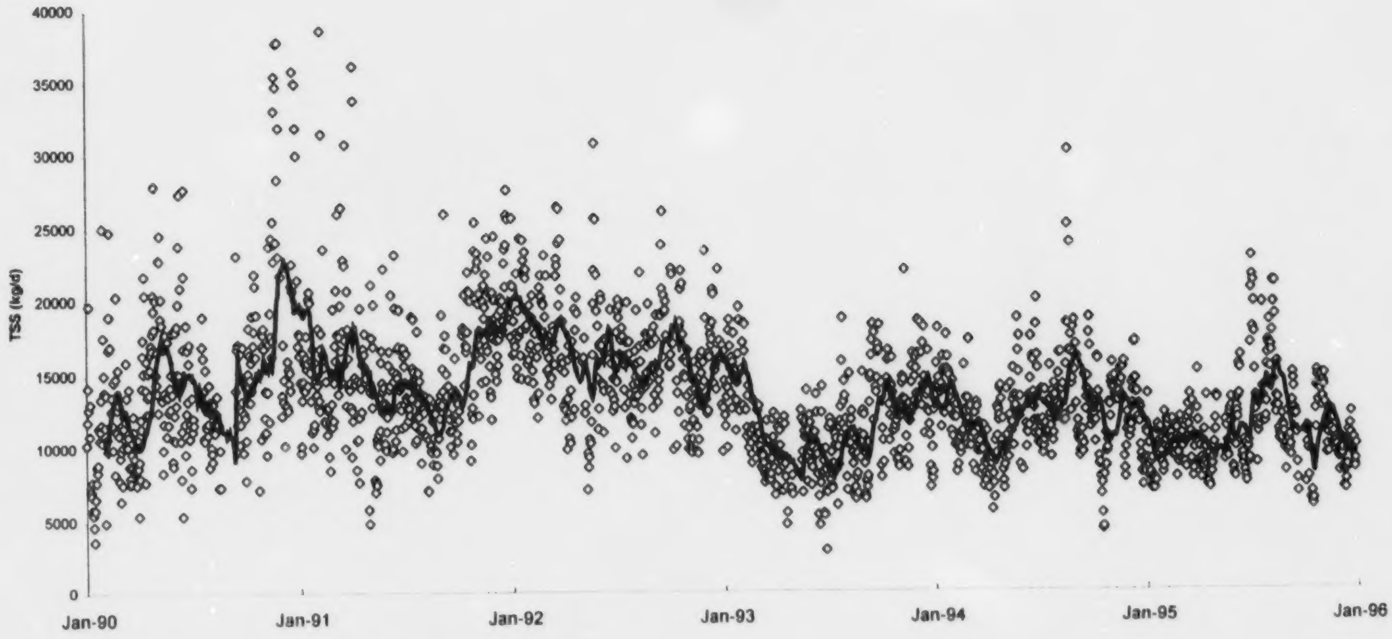
monthly (ADMTD) =
n/a

		average daily production (ADMTD):							aggregate production: *all plants:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Daishowa	to Athabasca	to all
average for:	1990	713.6	337.4	576.3	-		774.4	497.1	1627.3	2898.8
	1991	982.7	493.2	606.3	212.7		847.3	809.3	2294.6	3951.4
	1992	1045.4	587.6	608.3	322.2		852.8	1002.6	2583.5	4418.8
	1993	1046.7	614.0	632.3	325.9	866.1	836.8	1048.8	3385.0	5270.6
	1994	1082.3	634.0	692.2	365.2	1332.7	864.3	1034.6	4106.6	6005.4
	1995	1101.2	655.4	679.3	344.7	1473.4	847.8	1121.6	4254.1	6223.5
	1990-1995	998.7	581.4	615.8	315.9	1317.3	838.4	963.5	3828.1	5631.0

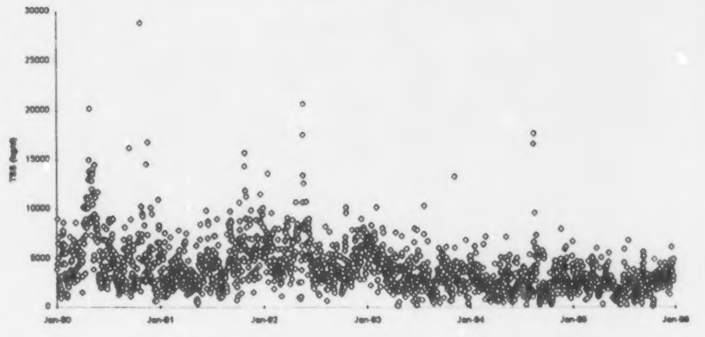
		average daily production-based production (ADMT /ADMT produced):							ratio of aggregates: *all plants:*		*BKP plants only:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Daishowa	to Athabasca	to all	to Athabasca	to all
average for:	1990	1.00	1.00	1.00	-		1.00	1.00	1.00	1.00	-	-
	1991	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	-	-
	1992	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	-	-
	1993	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-
	1994	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-
	1995	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-
	1990-1995	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-

Total Suspended Solids
(TSS)

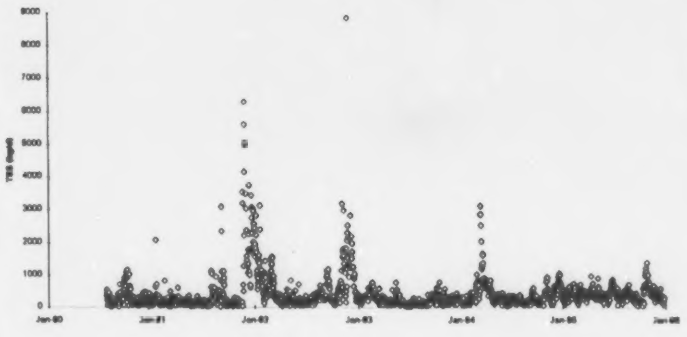
Performance Summary: Pulp Mills
Aggregate Daily TSS Loading - Time Series
all mills: 1990-1995 ; observed results and 30-day moving average



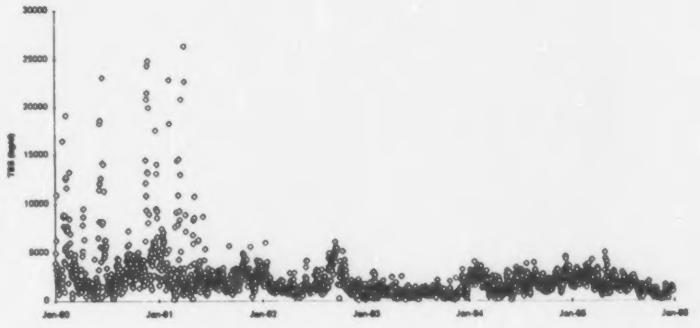
Performance Summary: Pulp Mills
Individual Daily TSS Loading - Time Series
Weldwood: 1990-1995



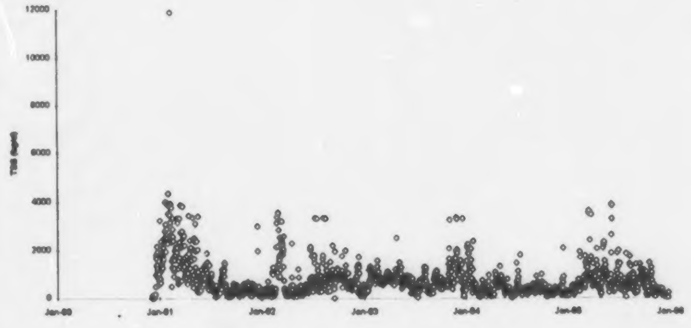
Performance Summary: Pulp Mills
Individual Daily TSS Loading - Time Series
Alberta Newsprint Company: 1990-1995



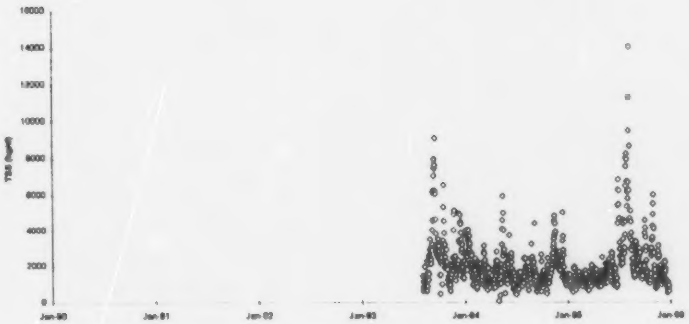
Performance Summary: Pulp Mills
Individual Daily TSS Loading - Time Series
Millar Western: 1990-1995



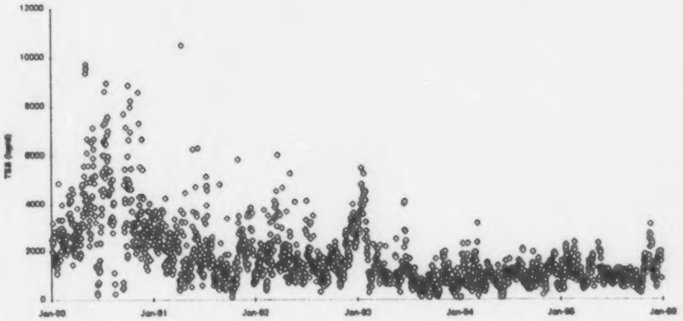
Performance Summary: Pulp Mills
Individual Daily TSS Loading - Time Series
Slave Lake Pulp Corporation: 1990-1995



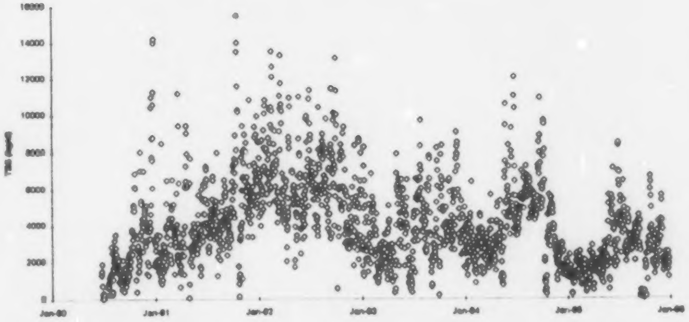
Performance Summary: Pulp Mills
Individual Daily TSS Loading - Time Series
Alberta-Pacific Forest Industries: 1990-1995



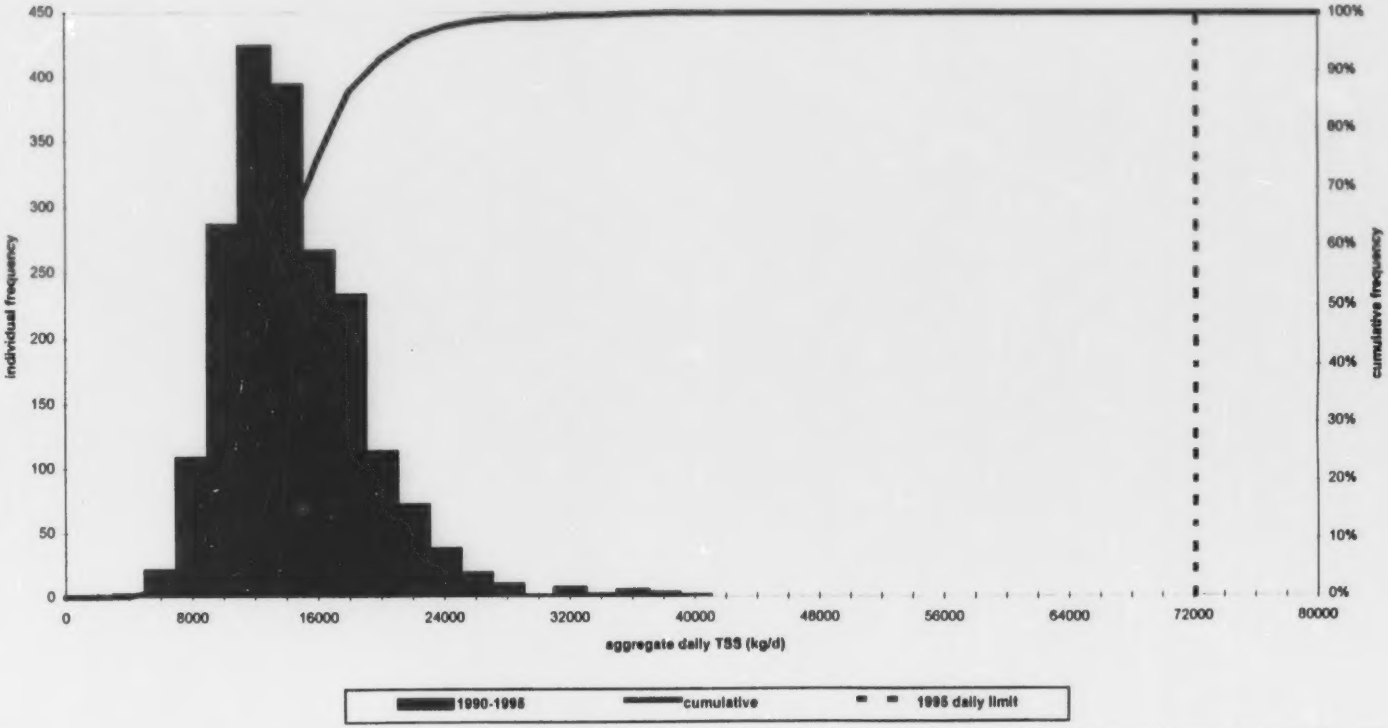
Performance Summary: Pulp Mills
Individual Daily TSS Loading - Time Series
Weyerhaeuser: 1990-1995



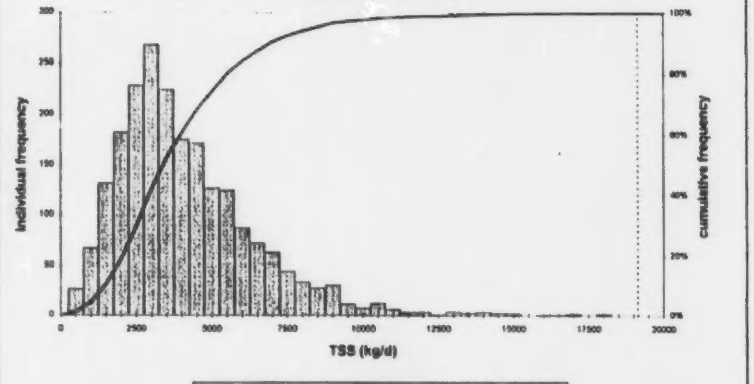
Performance Summary: Pulp Mills
Individual Daily TSS Loading - Time Series
Daishowa: 1990-1995



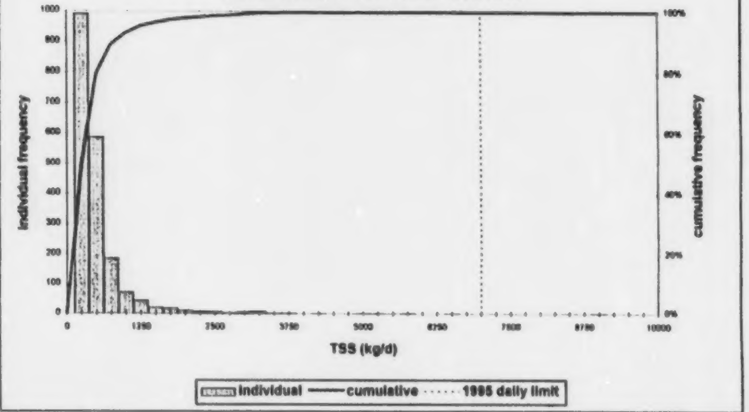
Performance Summary: Pulp Mills
Aggregate Daily TSS Loading - Frequency Distribution
all mills: 1990-1995



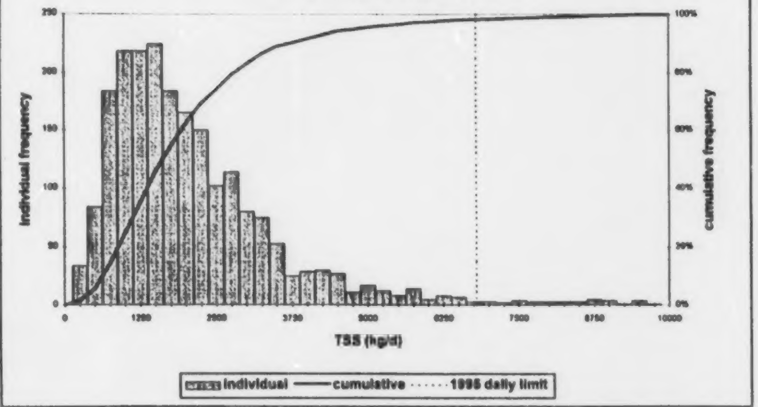
Performance Summary: Pulp Mills
Individual Daily TSS Loading - Frequency Distribution
Weldwood: 1990-1995



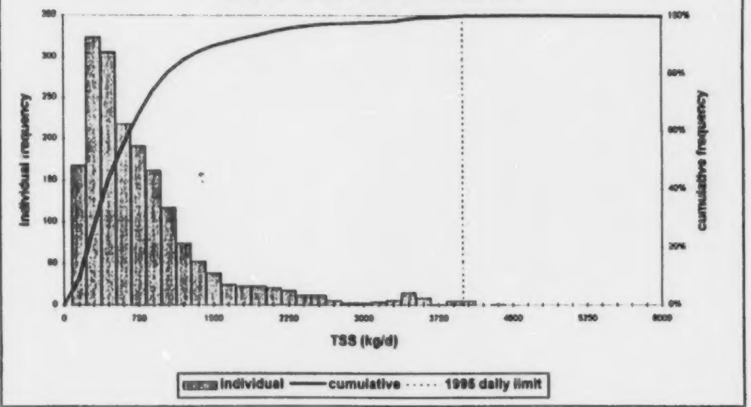
Performance Summary: Pulp Mills
Individual Daily TSS Loading - Frequency Distribution
Alberta Newsprint Company: 1990-1995

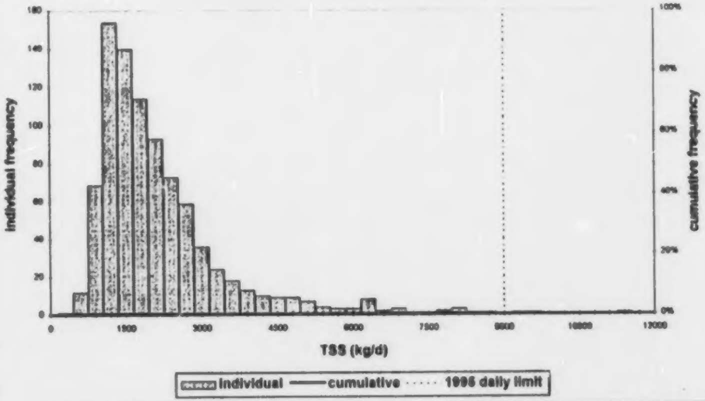


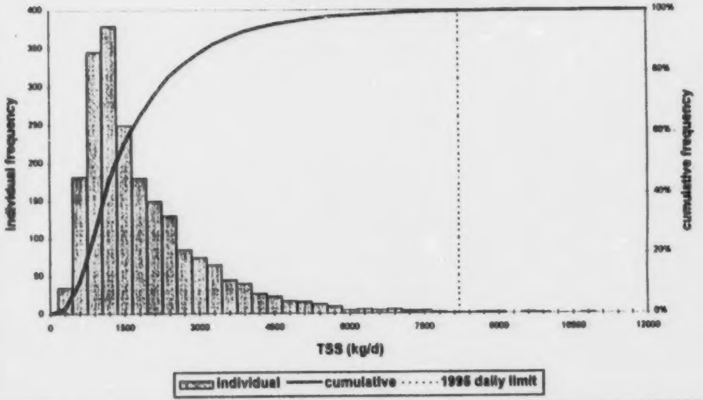
Performance Summary: Pulp Mills
Individual Daily TSS Loading - Frequency Distribution
Millar Western: 1990-1995

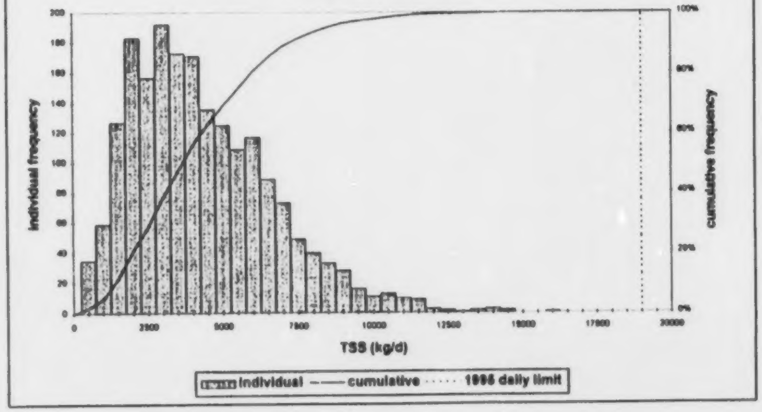


Performance Summary: Pulp Mills
Individual Daily TSS Loading - Frequency Distribution
Slave Lake Pulp Corporation: 1990-1995




Performance Summary: Pulp Mills
Individual Daily TSS Loading - Frequency Distribution
Alberta-Pacific Forest Industries: 1990-1996

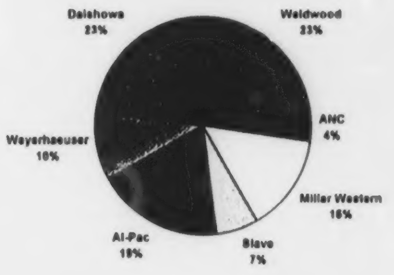

Performance Summary: Pulp Mills
Individual Daily TSS Loading - Frequency Distribution
Weyerhaeuser: 1990-1996


Performance Summary: Pulp Mills
Individual Daily TSS Loading - Frequency Distribution
Dalshowa: 1990-1996

Performance Summary: Pulp Mills

Average Daily TSS Loading for 1995

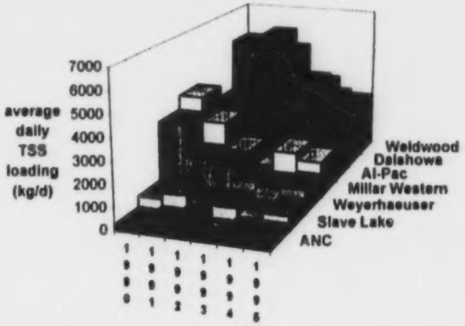
100% = 11063.7 kg/d aggregate TSS loading



Performance Summary: Pulp Mills

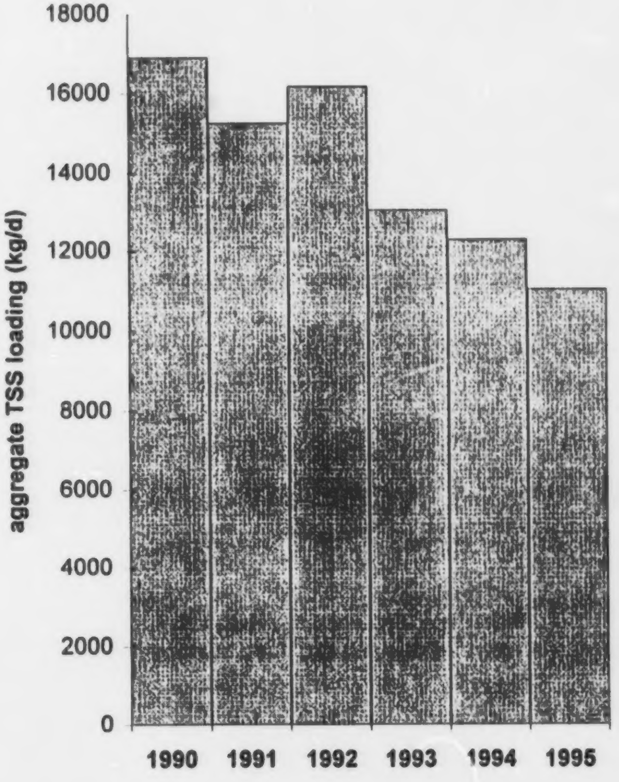
Annually Averaged Daily TSS Loading

all mills ; 1990-1995



TSS: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

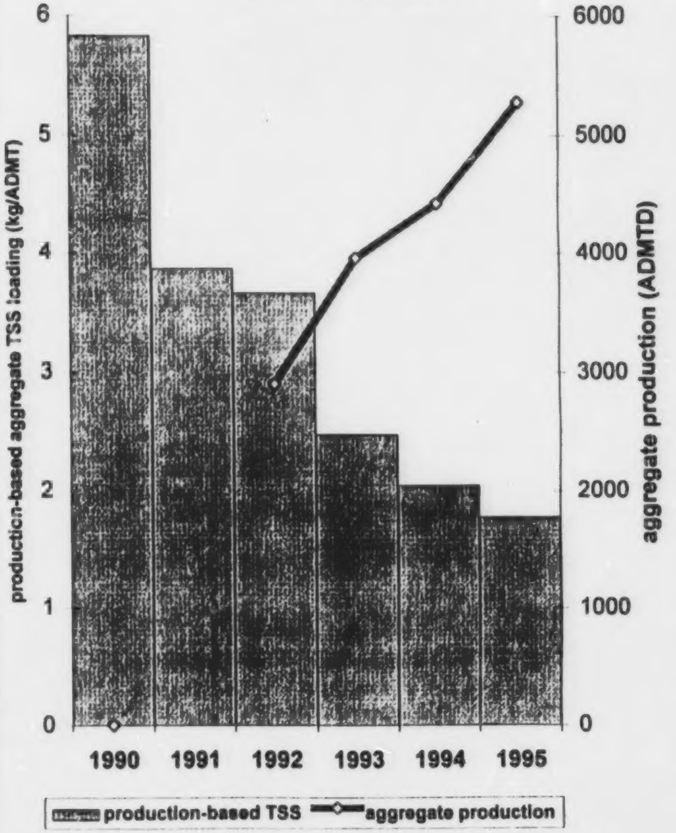
	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
mill	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Weldwood	5377.1	3336.5	4351.9	2354.9	5022.2	2365.2	3539.1	1876.5	2604.1	1840.3	2604.5	1191.0	19140	9570
ANC	277.8	231.1	464.6	882.1	601.4	740.5	222.1	147.7	377.9	385.9	397.8	198.6	7000	3500
Millar Western	4146.8	4085.5	3010.6	3042.3	1786.5	1165.3	913.8	527.5	1923.7	829.0	1618.2	841.4	6800	3400
Slave Lake	772.0	729.7	1062.0	1137.7	720.2	668.5	779.0	468.6	427.6	382.3	711.3	620.5	4000	2000
Al-Pac	-	-	-	-	-	-	2578.7	1610.8	1788.7	883.7	2072.9	1656.8	9000	4500
Weyerhaeuser	3479.8	1776.8	1971.6	1141.6	1770.7	886.0	1227.7	980.5	993.7	439.5	1120.6	492.1	8200	4100
Dalshowa	2858.5	2496.9	4421.2	2283.1	6286.7	2278.1	3800.0	1867.1	3991.7	2030.0	2538.4	1444.1	19000	9500



Performance Summary: Pulp Mills

Annually Averaged Aggregate Daily TSS Loading

all mills ; 1990-1995



Performance Summary: Pulp Mills

Annually Averaged Aggregate Daily TSS Loading

(production-based)

all mills ; 1990-1995

Pulp Mills: production-based summary of TSS loading
all mills ; 1990-1995

		average daily TSS loading (kg/d):							*aggregate:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa	to Athabasca	to all
total samples 1990-1995:		2170	1982	2159	1849	0	2114	1969		
average for:	1990	5377.1	277.8	4146.8	772.0		3479.8	2858.5	10573.7	16912.0
	1991	4351.9	464.6	3010.5	1062.0		1971.6	4421.2	8889.1	15281.9
	1992	5022.2	601.4	1786.5	720.2		1770.7	6286.7	8130.2	16187.6
	1993	3539.1	222.1	913.6	779.0	2578.7	1227.7	3800.0	8032.6	13060.4
	1994	2804.1	377.9	1923.7	427.6	1788.7	993.7	3991.7	7322.0	12307.4
	1995	2604.5	397.8	1618.2	711.3	2072.9	1120.6	2538.4	7404.7	11063.7
	1990-1995	3944.9	402.1	2238.7	740.7	-	1751.7	4087.3	7326.4	13165.3

aggregate limits for 1995:

daily (kg/d)=
72140

monthly (kg/d)=
36570

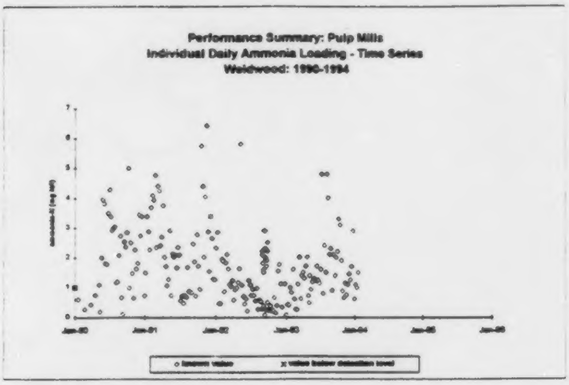
		average daily production (ADMTD):							aggregate production: *all plants:*	
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa	to Athabasca	to all
average for:	1990	713.6	337.4	576.3	-		774.4	497.1	1627.3	2898.8
	1991	982.7	493.2	606.3	212.7		847.3	809.3	2294.8	3951.4
	1992	1045.4	587.6	608.3	322.2		852.8	1002.5	2563.5	4418.8
	1993	1046.7	614.0	632.3	325.9	866.1	836.8	1048.8	3385.0	5270.6
	1994	1082.3	634.0	692.2	365.2	1332.7	864.3	1034.6	4106.5	6005.4
	1995	1101.2	655.4	679.3	344.7	1473.4	847.8	1121.6	4254.1	6223.5
	1990-1995	998.7	581.4	616.8	316.9	1317.3	838.4	963.5	3829.1	5631.0

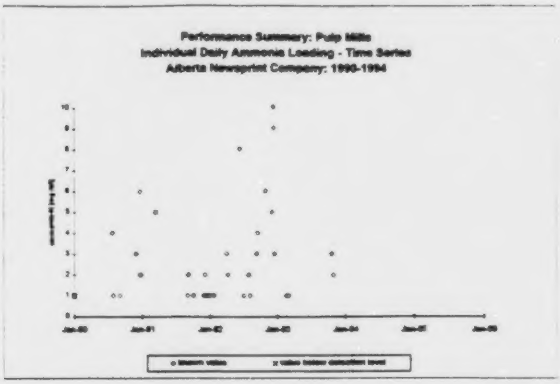
		average daily production-based TSS loading (kg TSS/ADMT produced):						
		Weldwood	ANC	Millar Western	Slave Lake	Al-Pac	Weyerhaeuser	Dalshowa
average for:	1990	7.54	0.82	7.20	-		4.49	5.75
	1991	4.43	0.94	4.97	4.99		2.33	5.46
	1992	4.80	1.02	2.94	2.24		2.08	6.27
	1993	3.38	0.36	1.72	2.39	2.98	1.47	3.62
	1994	2.59	0.60	2.78	1.17	1.34	1.15	3.86
	1995	2.37	0.61	2.38	2.06	1.41	1.32	2.26
	1990-1995	3.95	0.69	3.64	2.34	-	2.09	4.24

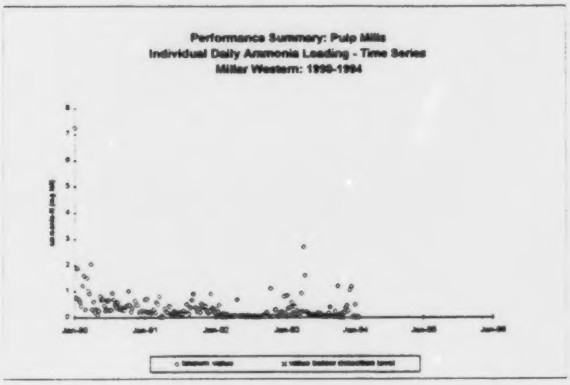
ratio of aggregates:	
to Athabasca	to all
6.50	5.83
3.87	3.87
3.17	3.66
2.37	2.48
1.78	2.05
1.74	1.78
1.91	2.34

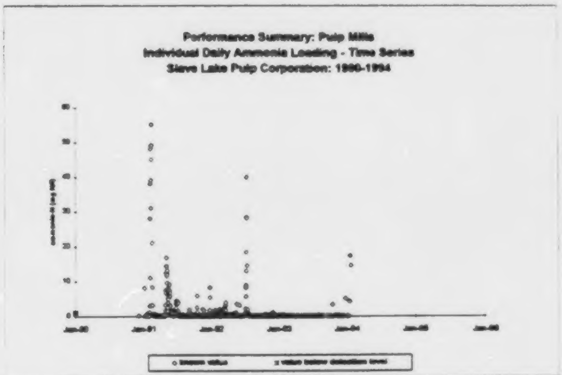
Nutrients

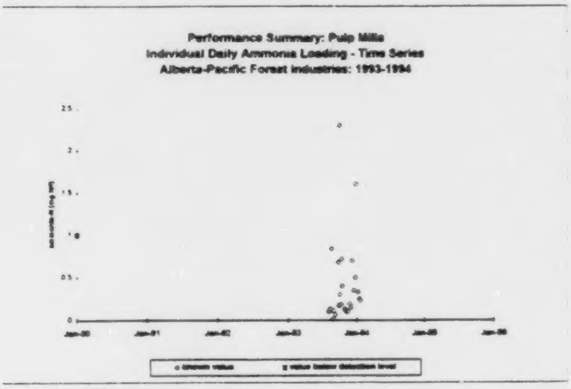
ammonia (as N) - mg N/l

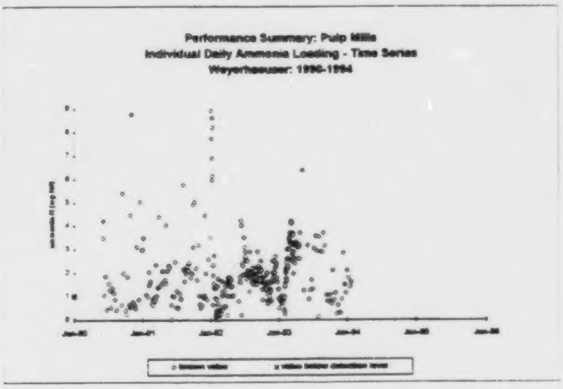

Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Weldwood: 1990-1994

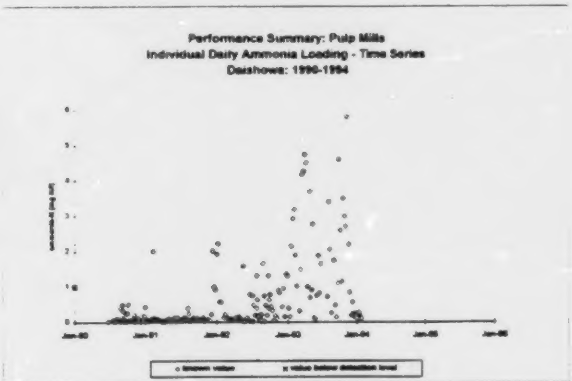

Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Alberta Newsprint Company: 1990-1994


Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Millar Western: 1990-1994


Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994


Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1994


Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Weyerhaeuser: 1990-1994

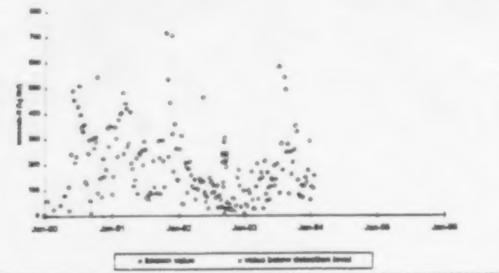

Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Daishowa: 1990-1994

number of samples:

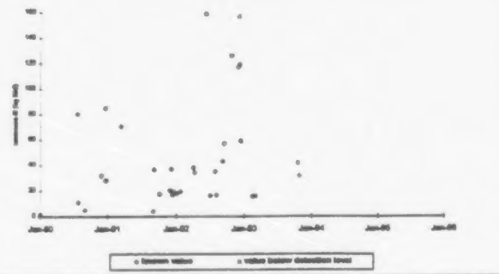
mill	above known detection level	below specified detection level	below unspecified detection level	total
Weldwood	225	1	0	226
ANC	35	1	0	36
Millar Western	211	2	0	213
Slave Lake	695	1	0	696
Al-Pac	27	1	0	28
Weyerhaeuser	367	1	1	369
Daishowa-Marubeni	251	2	0	253

ammonia (as N) - kg N/d

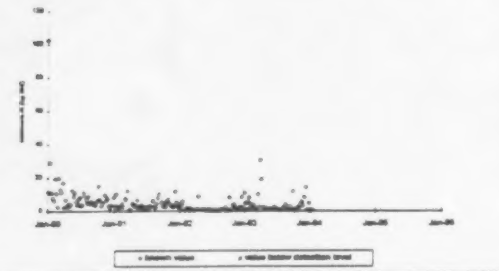
Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Weldwood: 1990-1994



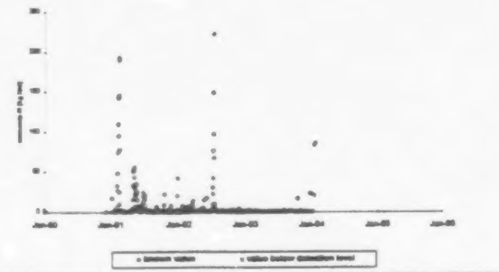
Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Alberta Newsprint Company: 1990-1994



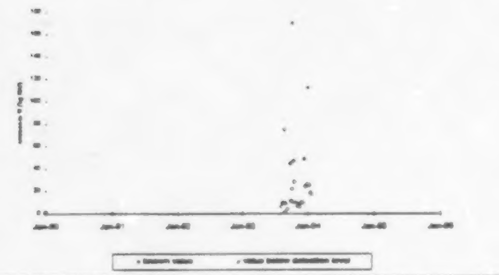
Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Miller Western: 1990-1994



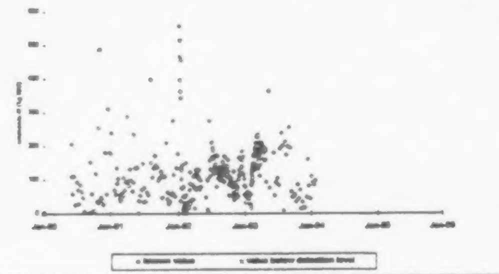
Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994



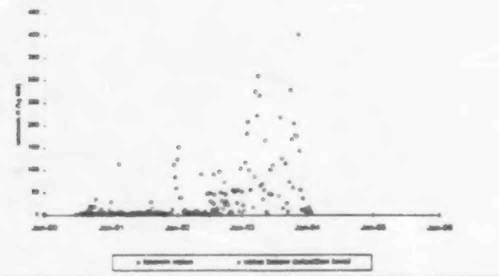
Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1994



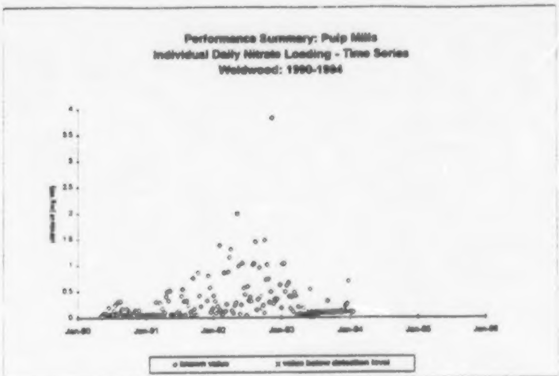
Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Weyerhaeuser: 1990-1994

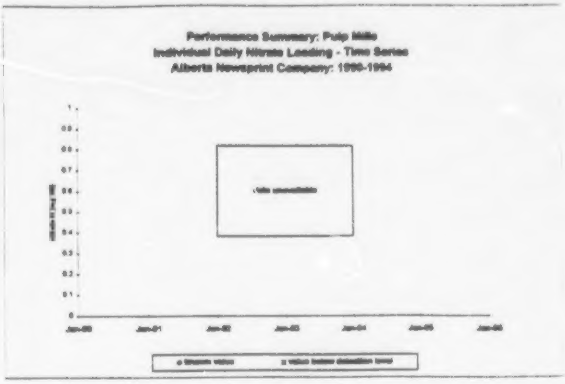


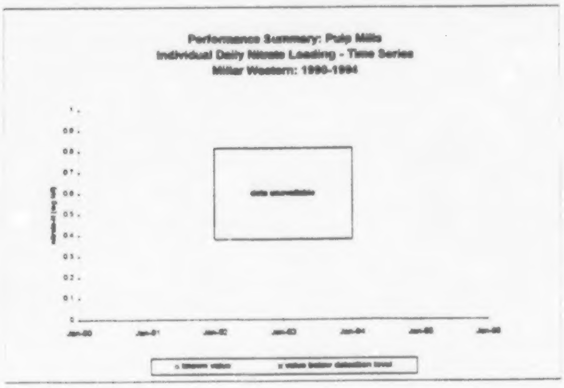
Performance Summary: Pulp Mills
Individual Daily Ammonia Loading - Time Series
Daishowa: 1990-1994

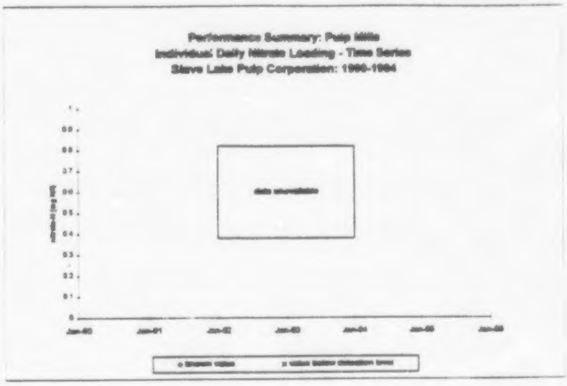


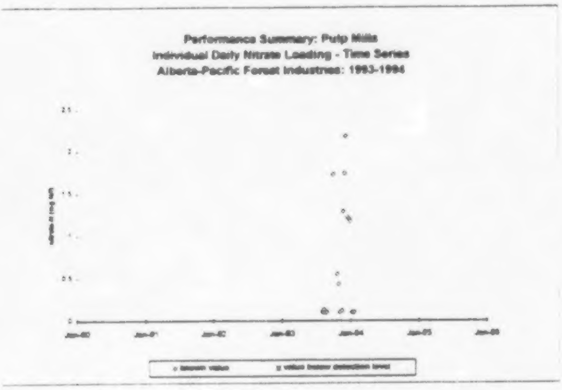
nitrate (as N) - mg N/l

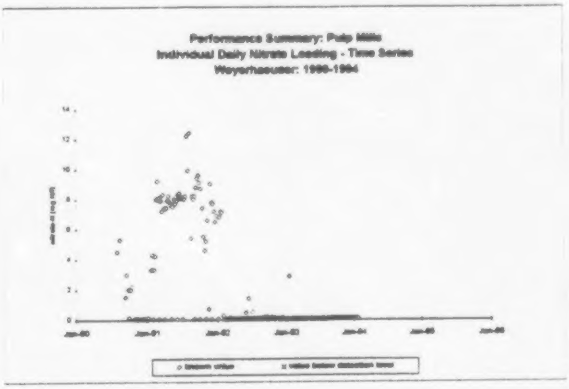

Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Weldwood: 1990-1994

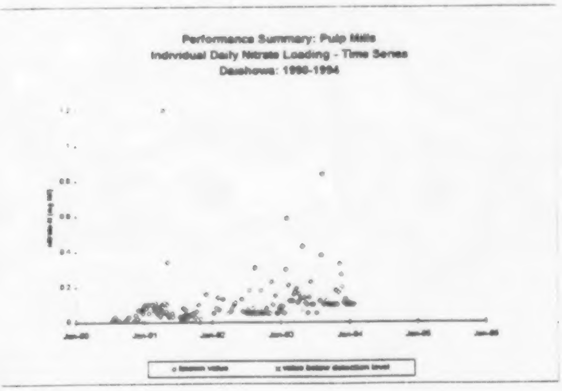

Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Alberta Newsprint Company: 1990-1994


Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Millar Western: 1990-1994


Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994


Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1994

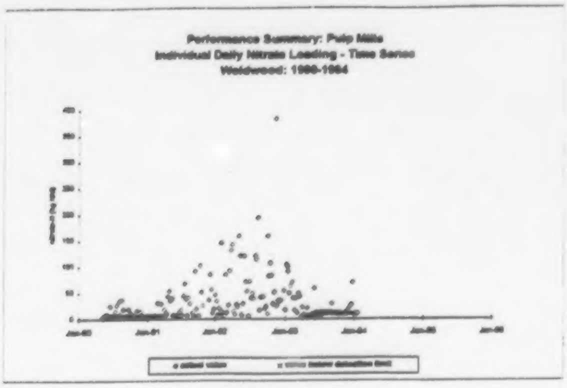

Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Weyerhaeuser: 1990-1994

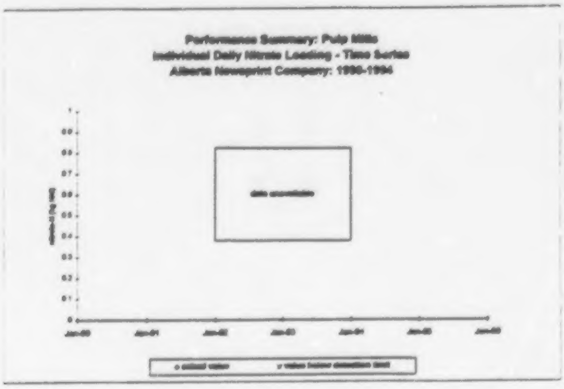

Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Daishowa: 1990-1994

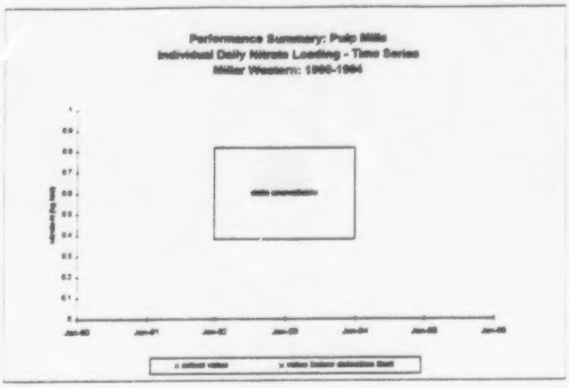
number of samples

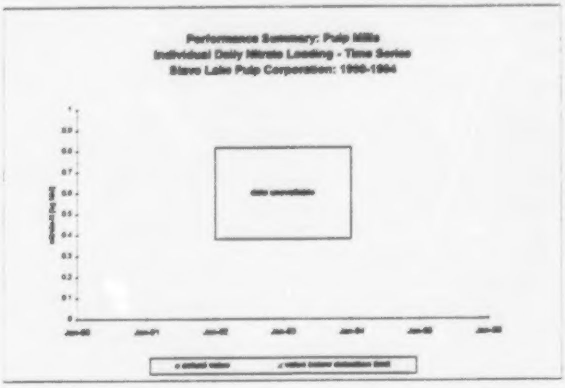
mill	above known detection level	below specified detection level	below unspecified detection level	total
Weldwood	172	28	0	200
ANC	0	0	0	0
Millar Western	0	0	0	0
Slave Lake	0	0	0	0
Al-Pac	17	0	0	17
Weyerhaeuser	197	0	0	197
Daishowa-Marubeni	169	0	0	169

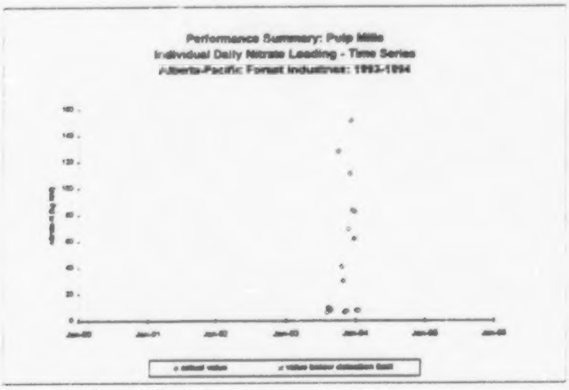
nitrate (as N) - kg N/d

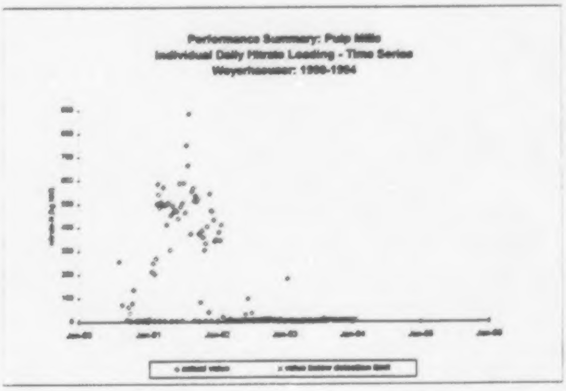

Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Weldwood: 1990-1994

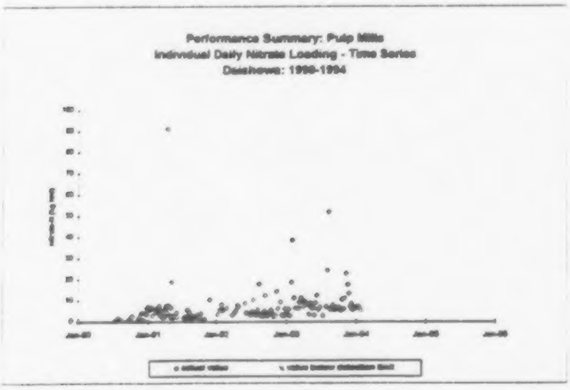

Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Alberta Newsprint Company: 1990-1994


Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Millar Western: 1990-1994

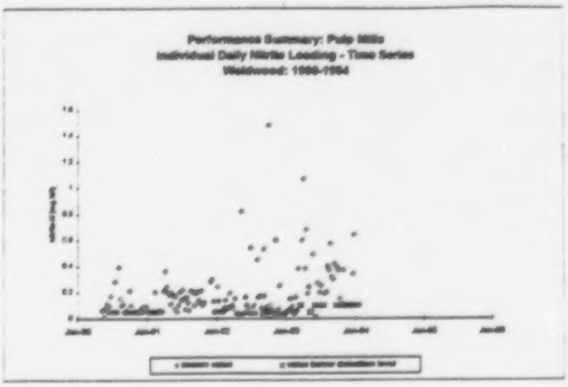

Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994

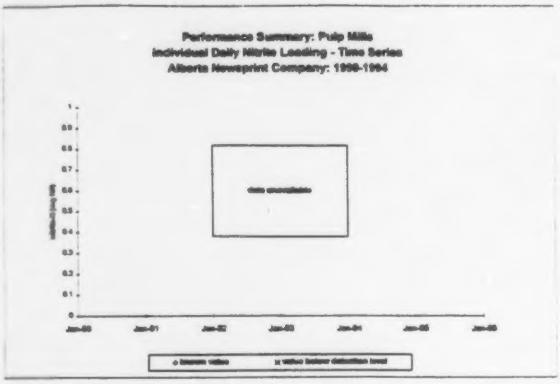

Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1994

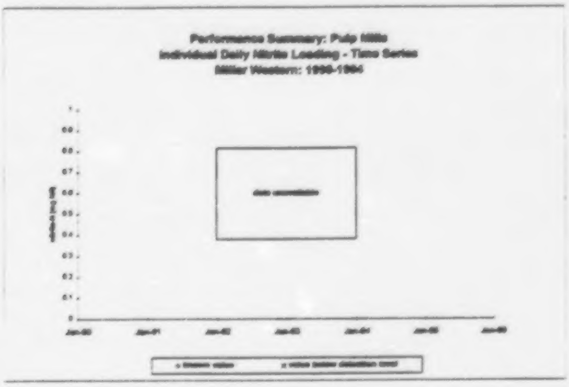

Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Weyerhaeuser: 1990-1994

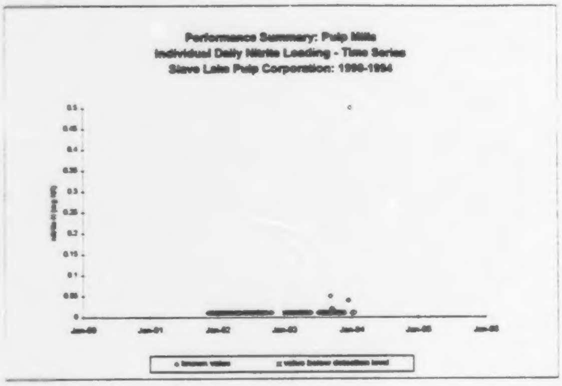

Performance Summary: Pulp Mills
Individual Daily Nitrate Loading - Time Series
Daishowa: 1990-1994

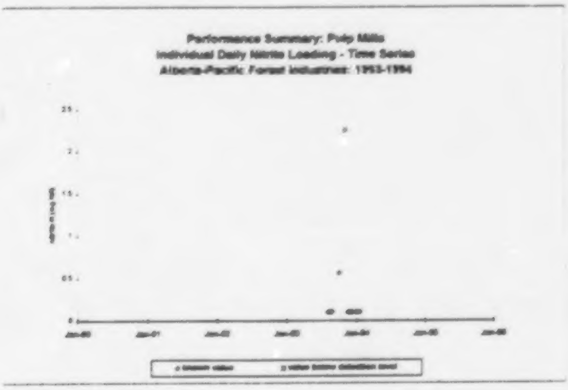
nitrite (as N) - mg/l

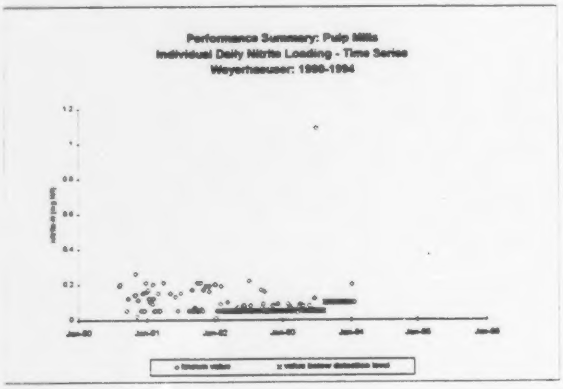


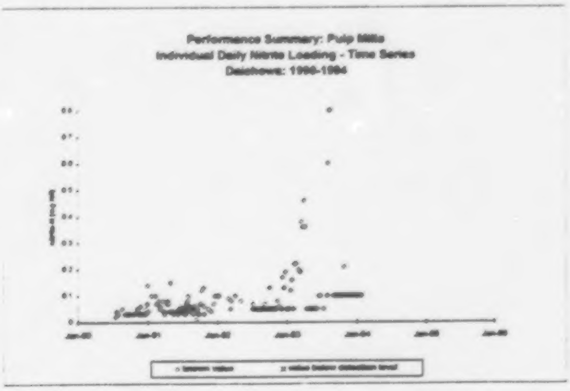








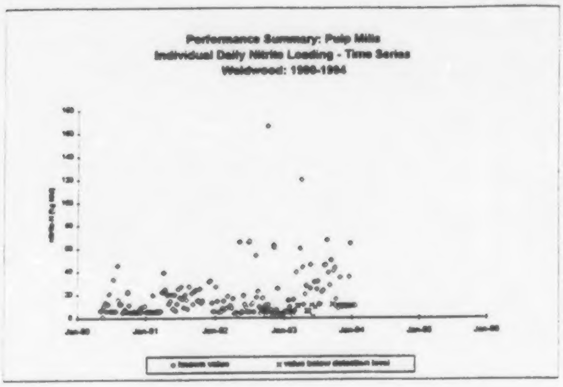


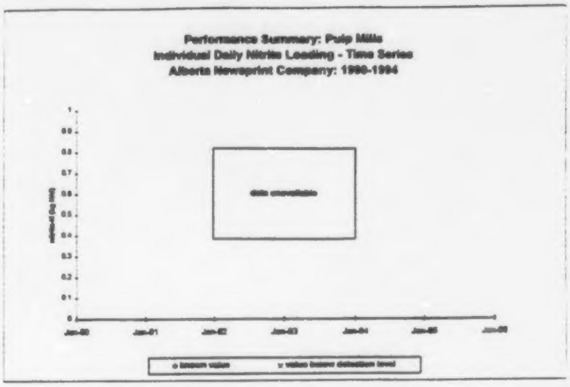


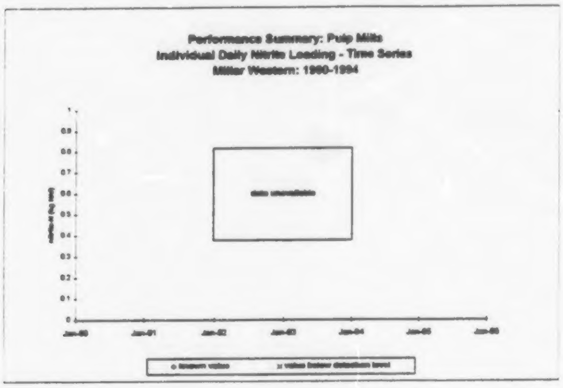
number of samples:

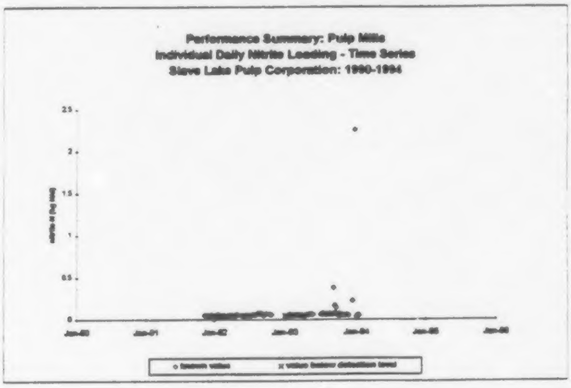
mill	above known detection level	below specified detection level	below unspecified detection level	total
Weldwood	186	21	0	207
ANC	0	0	0	0
Millar Western	0	0	0	0
Slave Lake	82	10	4	96
Al-Pac	13	0	0	13
Weyerhaeuser	107	73	0	180
Daishowa-Marubeni	181	0	0	181

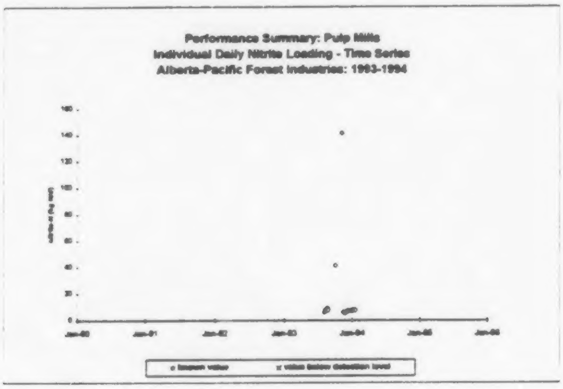
nitrite (as N) - kg/d

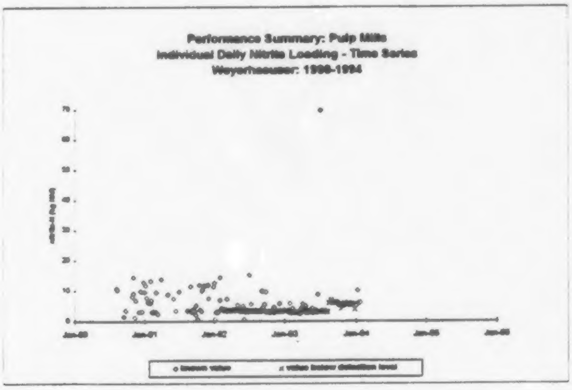


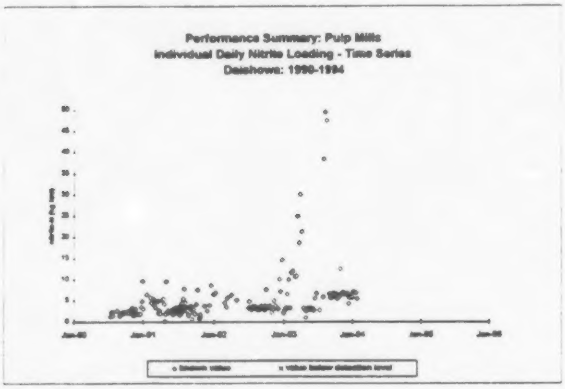




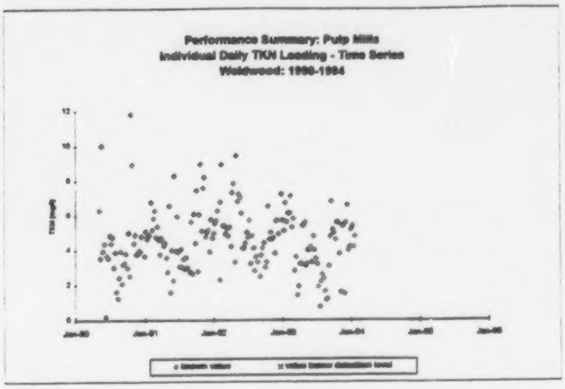


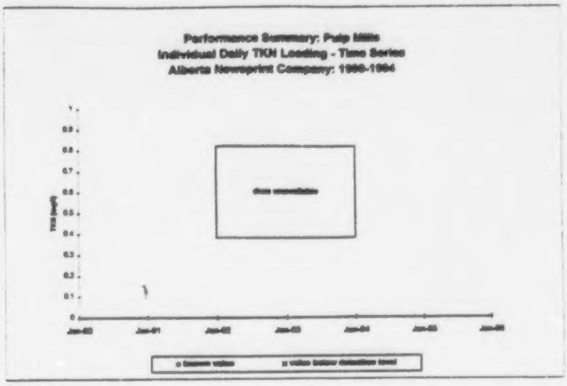


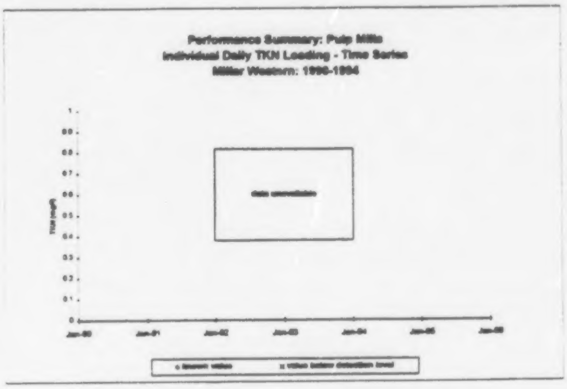


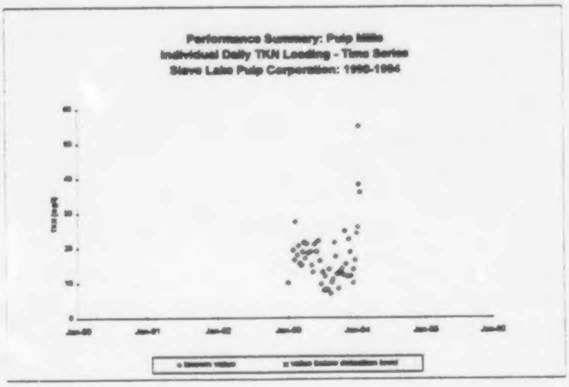


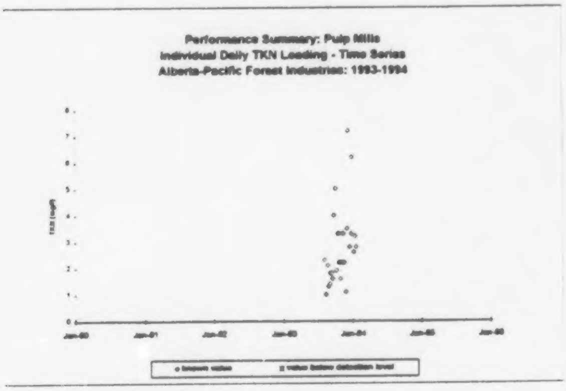
total Kjeldahl nitrogen (TKN) - mg/l

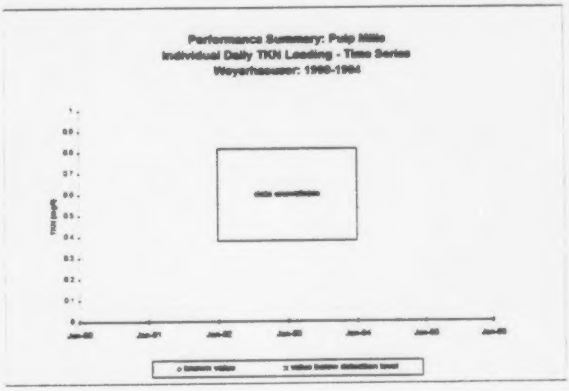


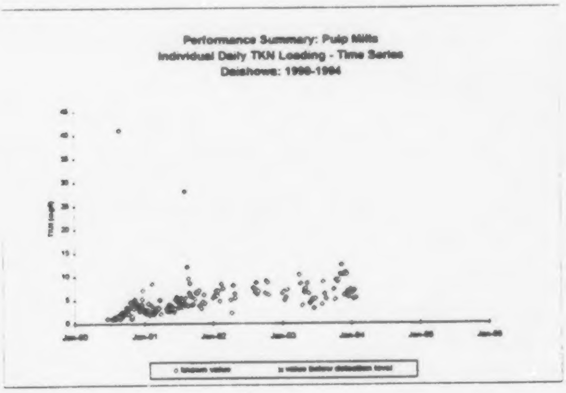








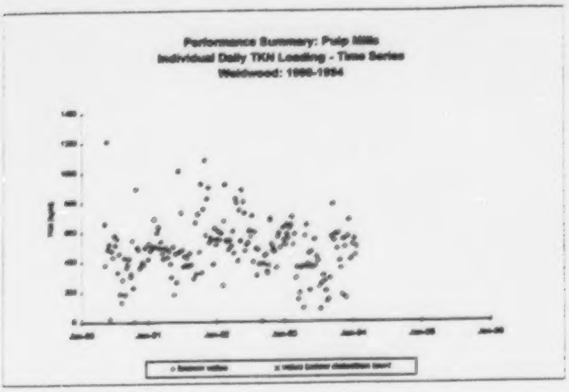


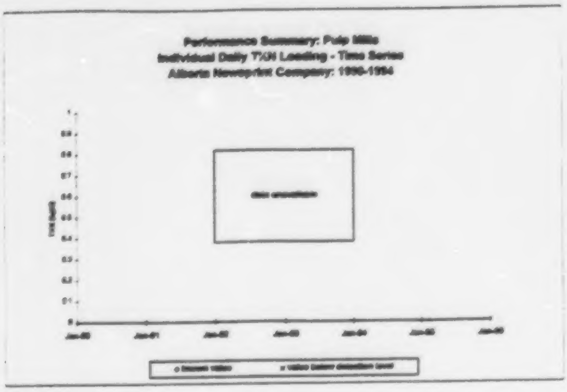


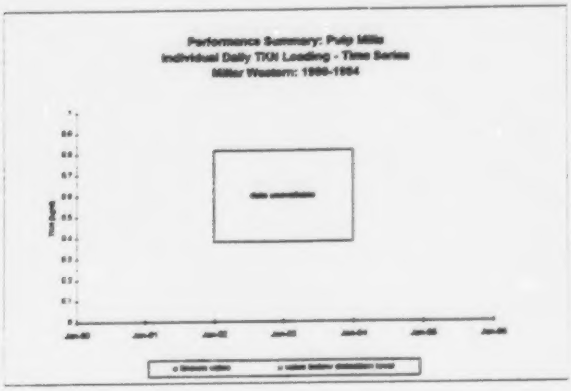
number of samples

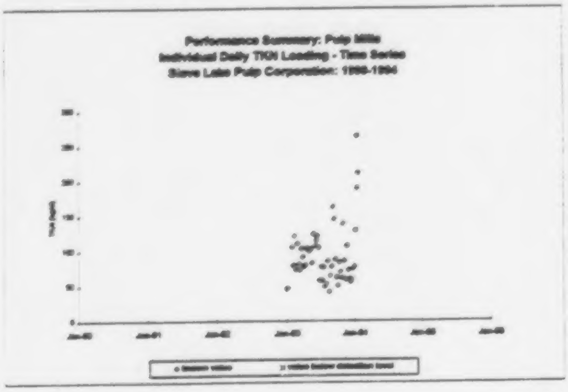
mill	above known detection level	below specified detection level	below unspecified detection level	total
Weldwood	203	0	0	203
ANC	0	0	0	0
Miller Western	0	0	0	0
Slave Lake	53	0	0	53
Al-Pac	26	0	0	26
Weyerhaeuser	0	0	0	0
Daishowa-Marubeni	191	0	0	19,

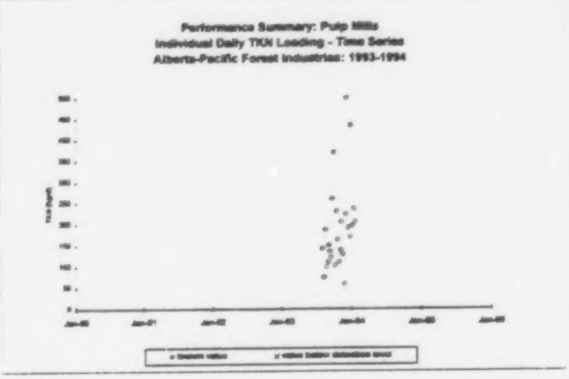
total Kjeldahl nitrogen (TKN) - kg/d

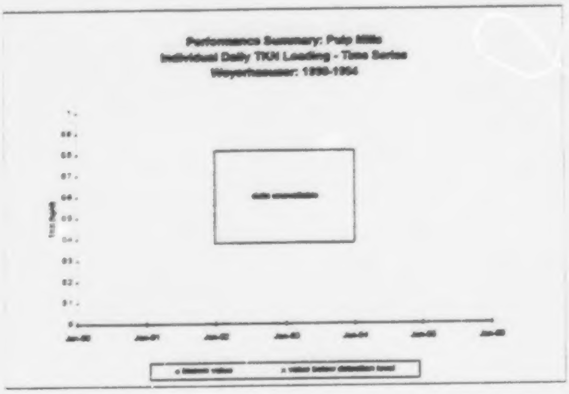


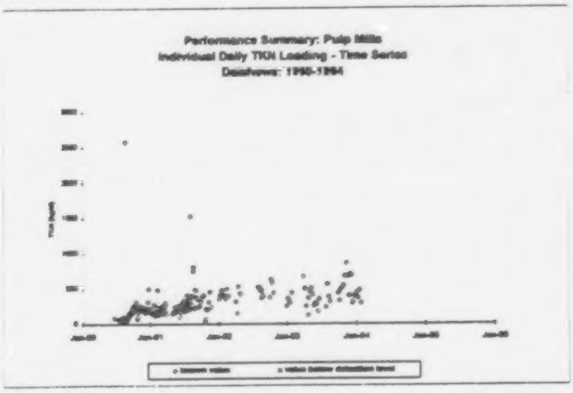




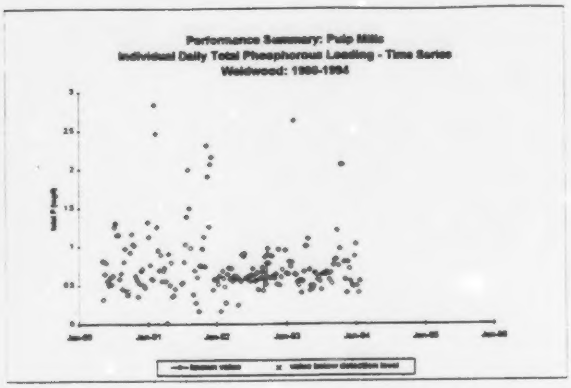


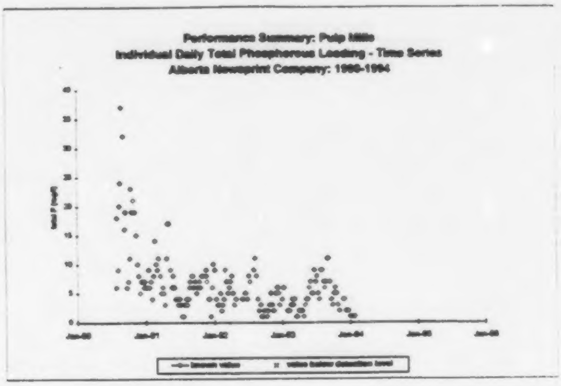


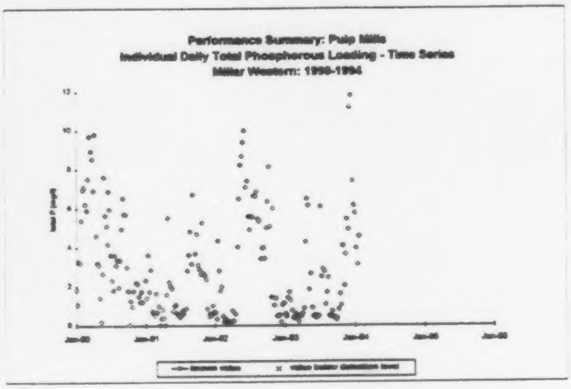


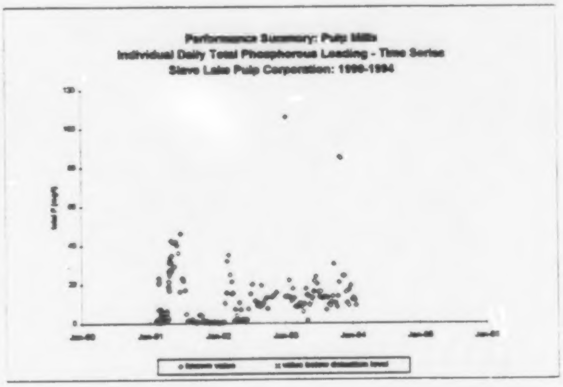


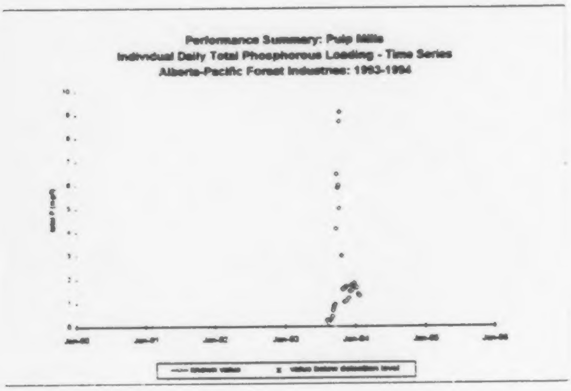
total phosphorous - mg/l

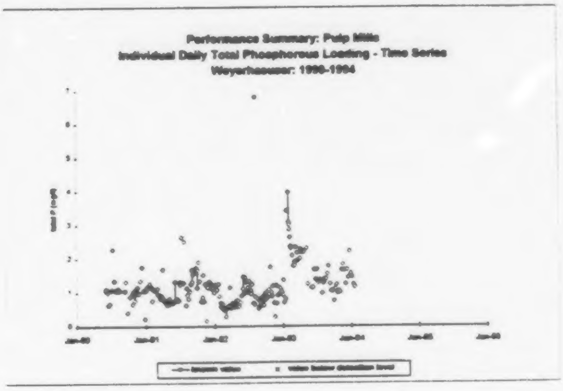


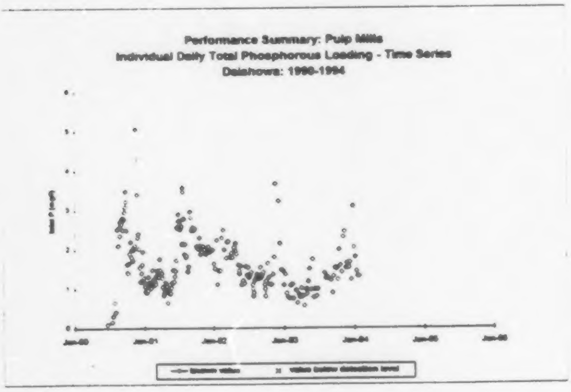








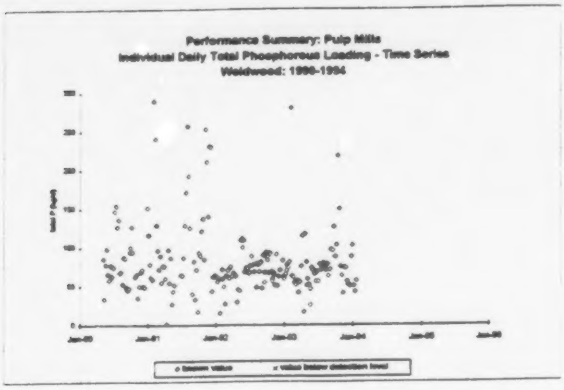




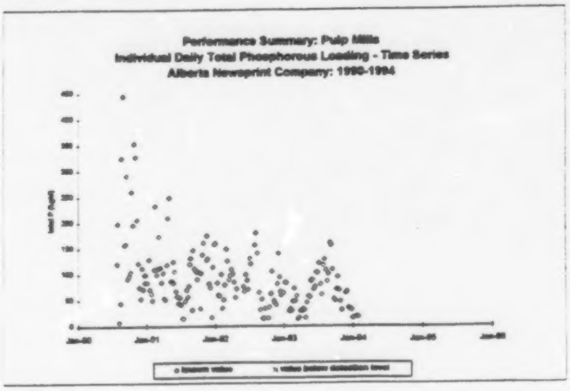
number of samples:

mill	above known detection level	below specified detection level	below unspecified detection level	total
Weldwood	206	0	0	206
ANC	177	0	0	177
Miller Western	213	0	0	213
Slave Lake	207	0	4	211
Al-Pac	29	0	0	29
Weyerhaeuser	218	0	0	218
Daishowa-Marubeni	251	0	0	251

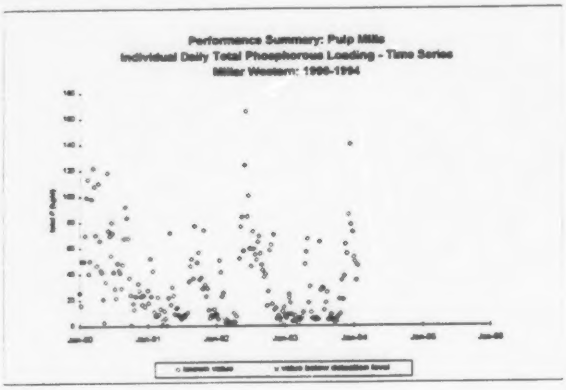
total phosphorous - kg/d



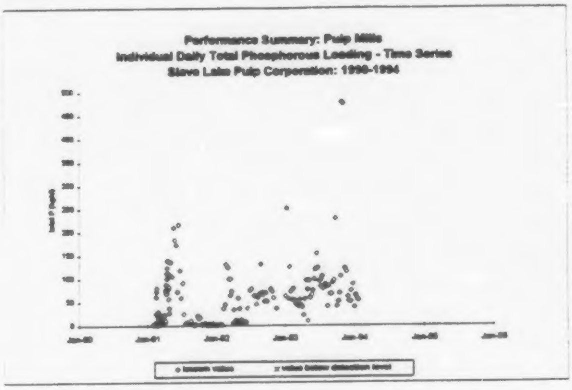
Performance Summary: Pulp Mills
Individual Daily Total Phosphorous Loading - Time Series
Weldwood: 1990-1994



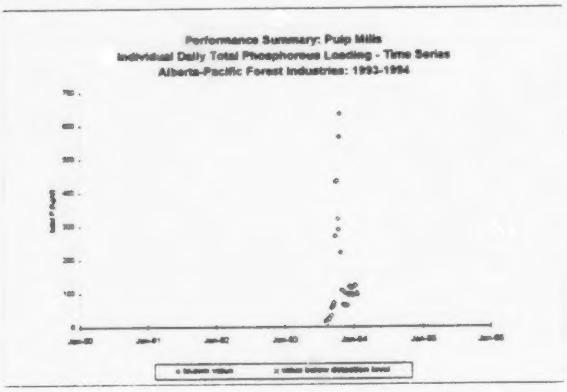
Performance Summary: Pulp Mills
Individual Daily Total Phosphorous Loading - Time Series
Alberta Newsprint Company: 1990-1994



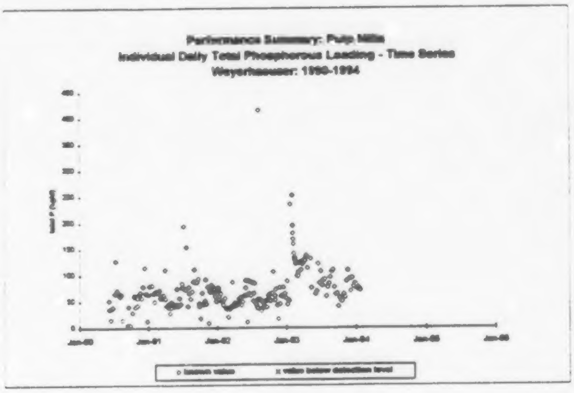
Performance Summary: Pulp Mills
Individual Daily Total Phosphorous Loading - Time Series
Millar Western: 1990-1994



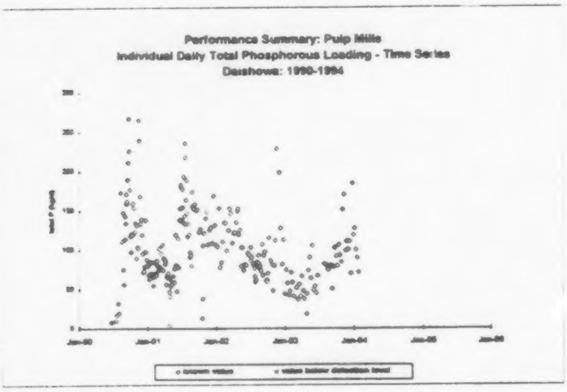
Performance Summary: Pulp Mills
Individual Daily Total Phosphorous Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994



Performance Summary: Pulp Mills
Individual Daily Total Phosphorous Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1994



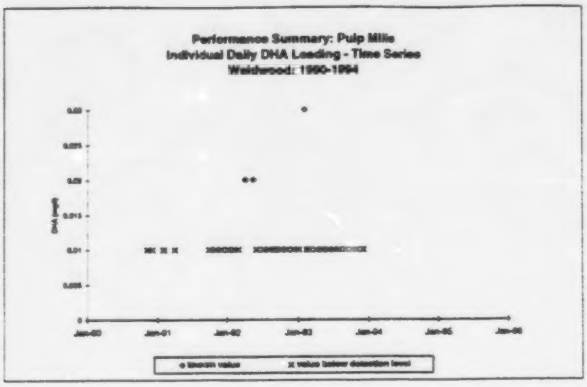
Performance Summary: Pulp Mills
Individual Daily Total Phosphorous Loading - Time Series
Weyerhaeuser: 1990-1994

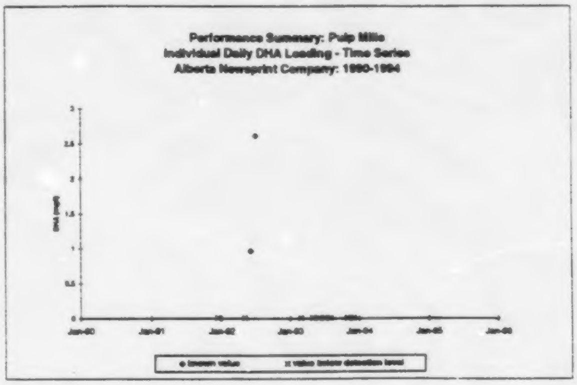


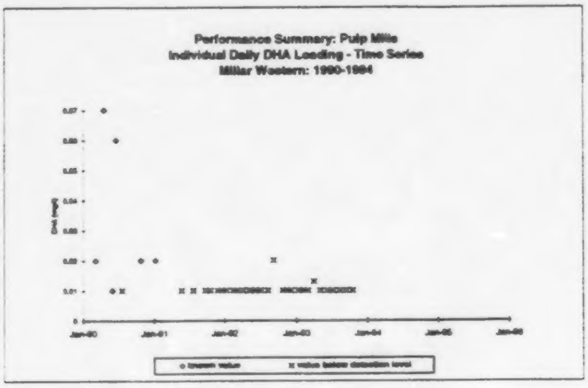
Performance Summary: Pulp Mills
Individual Daily Total Phosphorous Loading - Time Series
Daishowa: 1990-1994

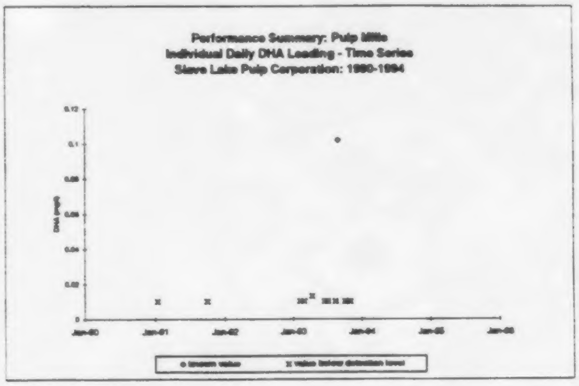
Trace Organics

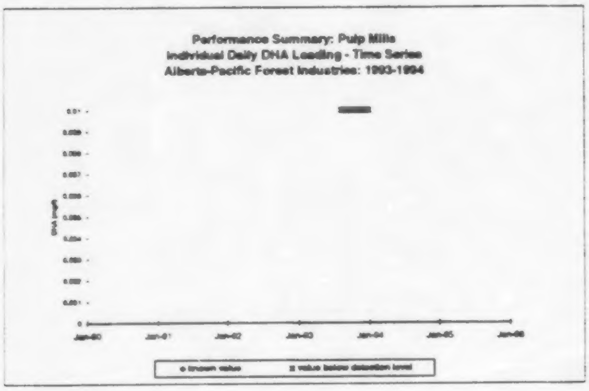
dehydroabietic acid (DHA) - mg/l

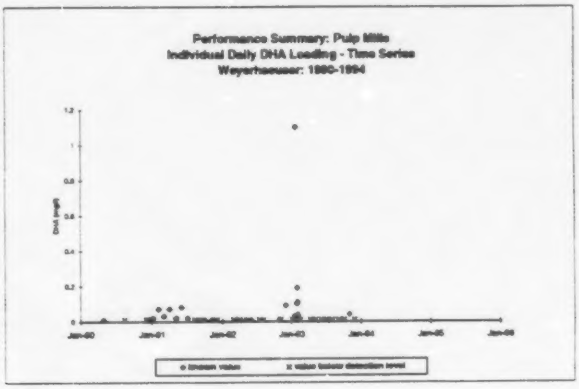


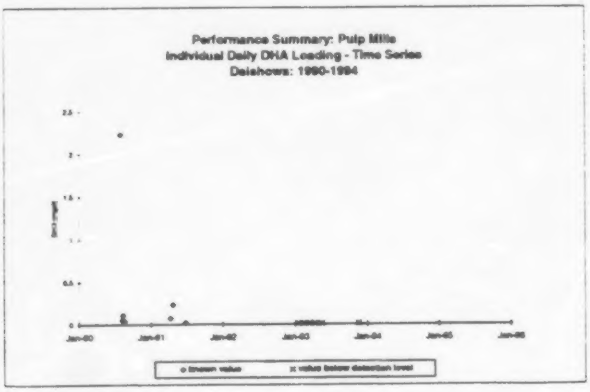








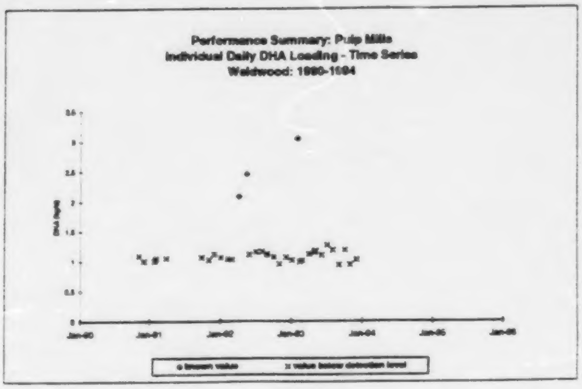


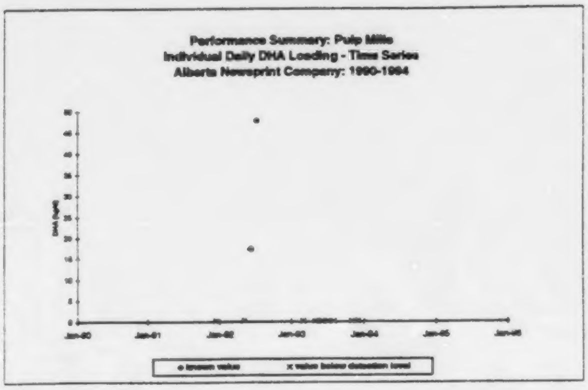


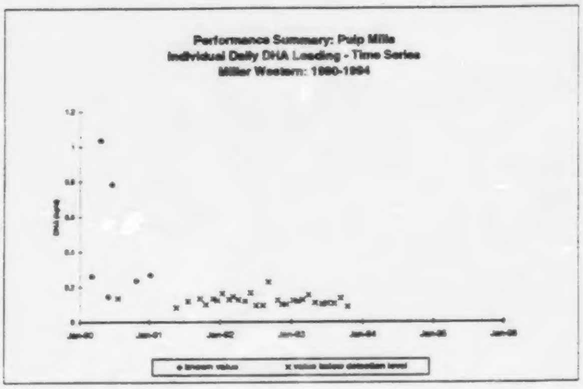
number of samples

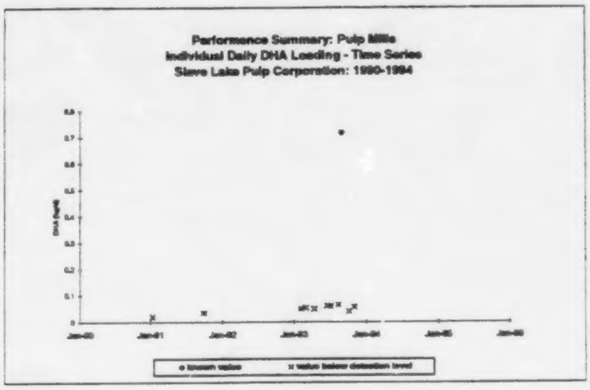
mill	above known detection level	below specified detection level	below unspecified detection level	total
Waldwood	4	31	1	36
ANC	2	10	9	21
Millar Western	6	29	0	35
Slave Lake	1	10	0	11
Al-Pac	0	25	0	25
Weyerhaeuser	24	21	0	45
Daishowa-Marubeni	8	6	30	44

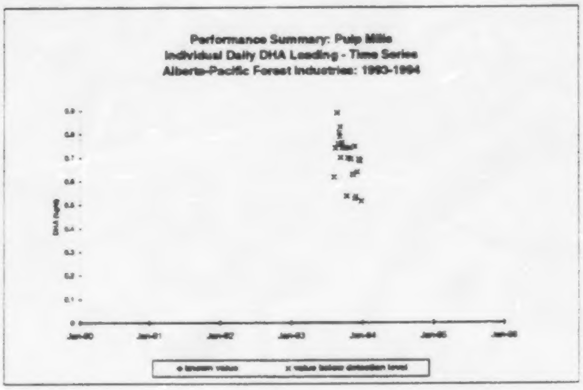
dehydroabietic acid (DHA) - kg/d

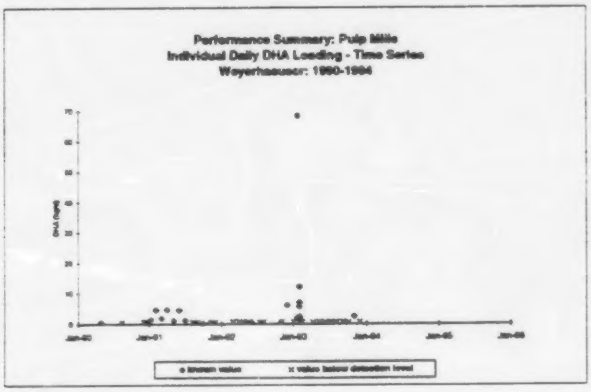

Performance Summary: Pulp Mills
Individual Daily DHA Loading - Time Series
Weldwood: 1990-1994

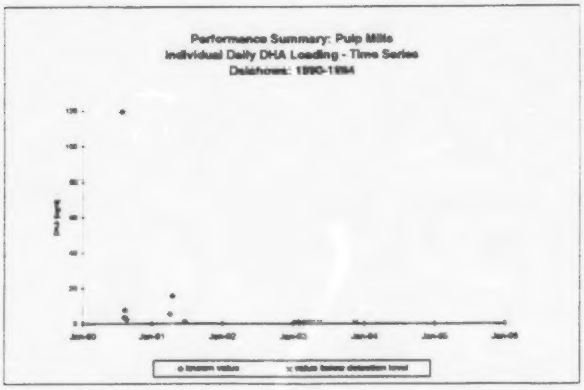

Performance Summary: Pulp Mills
Individual Daily DHA Loading - Time Series
Alberta Newsprint Company: 1990-1994


Performance Summary: Pulp Mills
Individual Daily DHA Loading - Time Series
Miller Western: 1990-1994

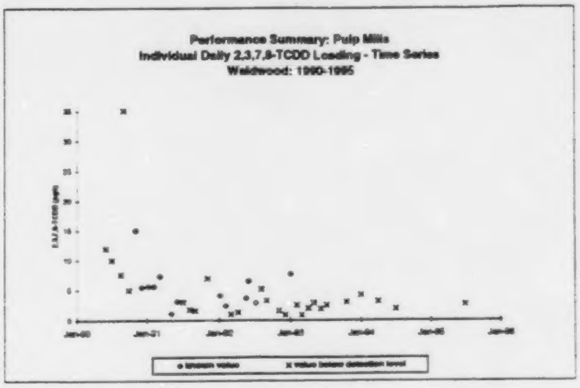

Performance Summary: Pulp Mills
Individual Daily DHA Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994

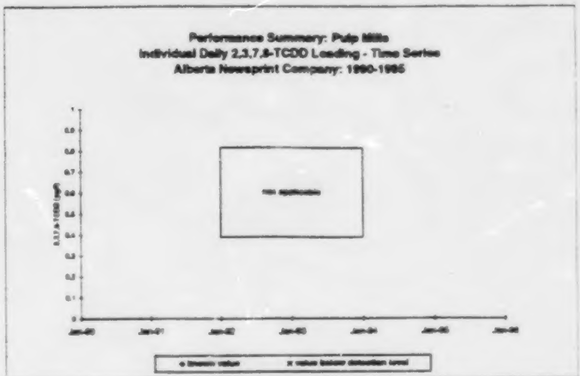

Performance Summary: Pulp Mills
Individual Daily DHA Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1994

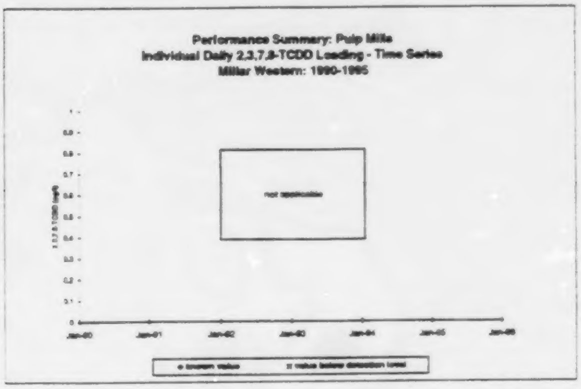

Performance Summary: Pulp Mills
Individual Daily DHA Loading - Time Series
Weyerhaeuser: 1990-1994

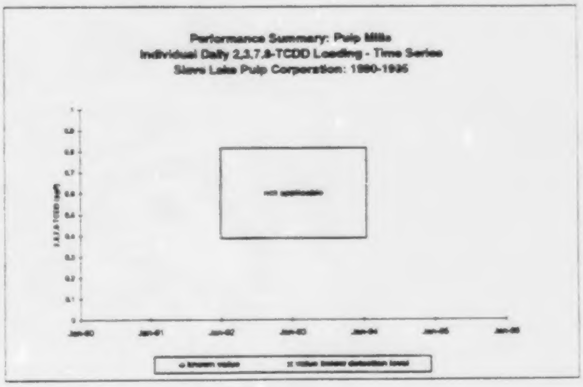

Performance Summary: Pulp Mills
Individual Daily DHA Loading - Time Series
Daishowa: 1990-1994

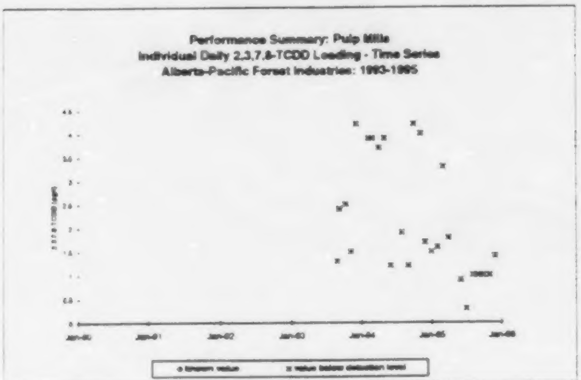
2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) - pg/l

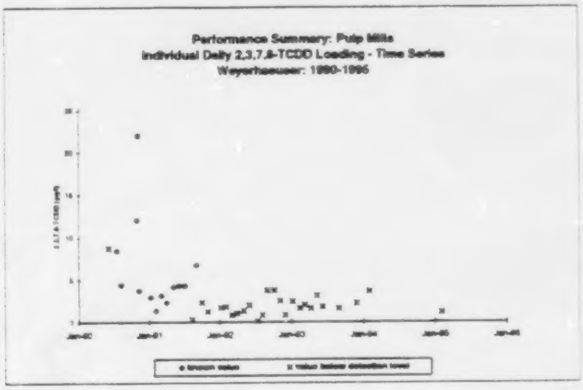


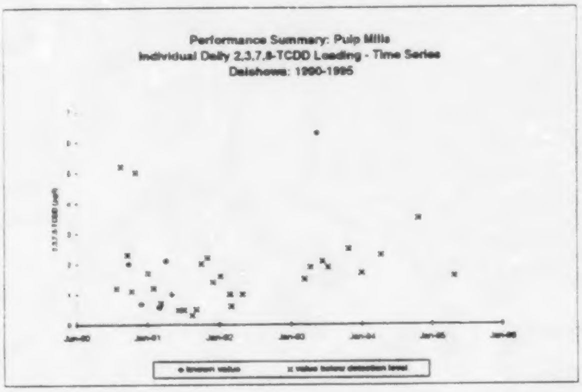










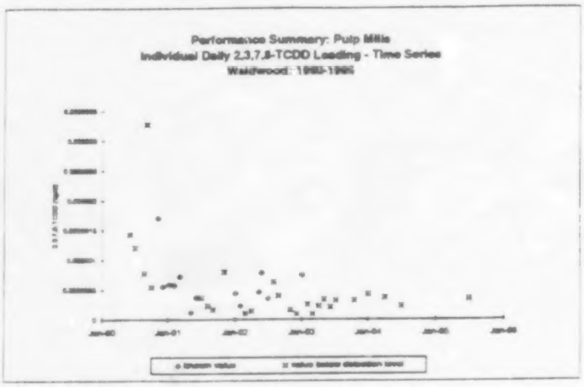


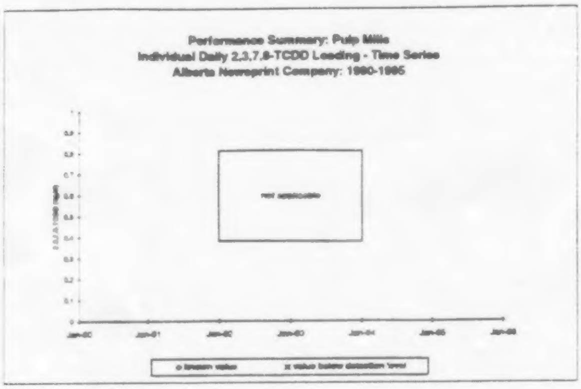
SUMMARY for 2,3,7,8-TCDD:

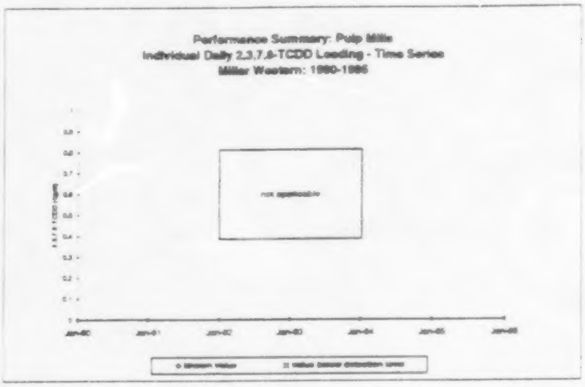
non-measurable detection levels 15 pg/l

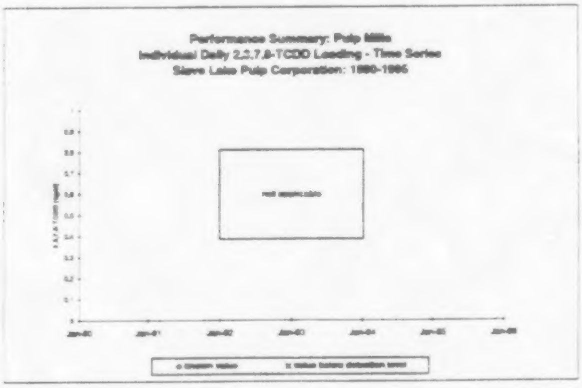
mill	values above known detection level	values below specified detection level	values below unspecified detection level	values above known detection level but below specified non-measurable level (1992 onward)
Weldwood	13	26	0	6
ANC	n/a	n/a	n/a	n/a
Millar Western	n/a	n/a	n/a	n/a
Slave Lake	n/a	n/a	n/a	n/a
Al-Pac	0	26	0	0
Weyerhaeuser	13	26	0	0
Daishowa-Marubeni	6	29	0	1

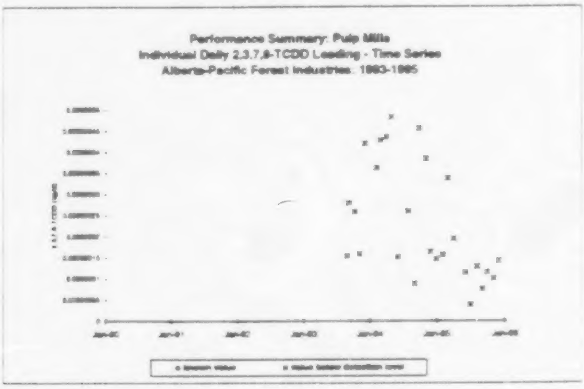
2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) - kg/d

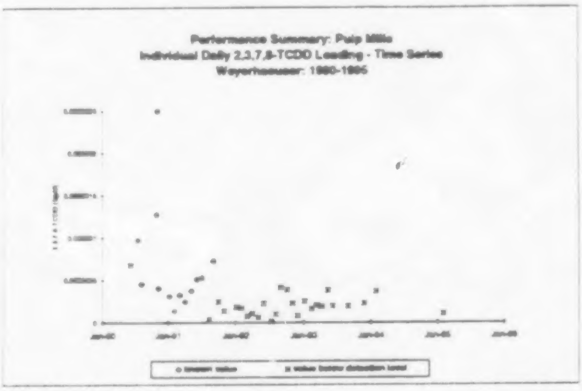

Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDD Loading - Time Series
Weldwood: 1990-1995

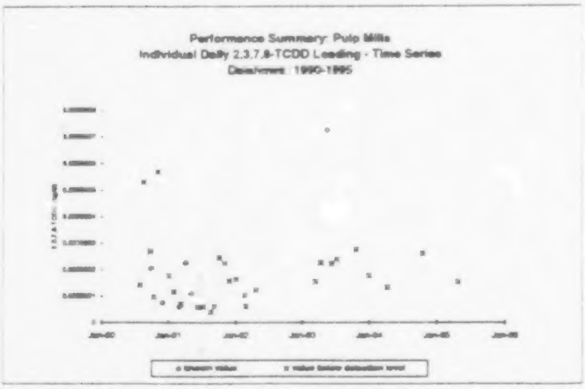

Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDD Loading - Time Series
Alberta Newsprint Company: 1990-1995


Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDD Loading - Time Series
Millar Western: 1990-1995

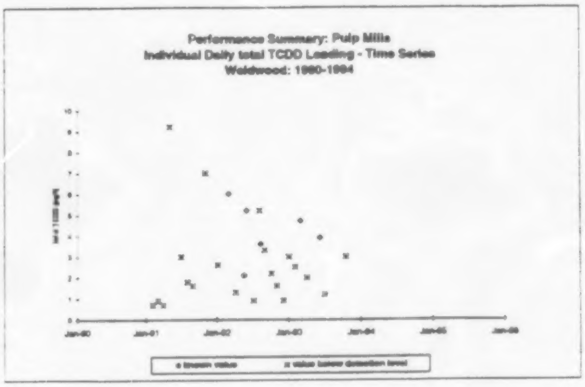

Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDD Loading - Time Series
Slave Lake Pulp Corporation: 1990-1995

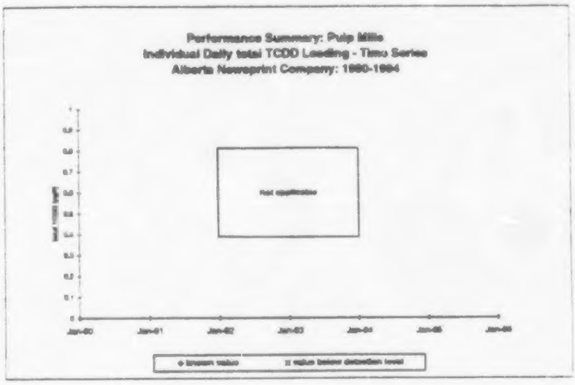

Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDD Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1995

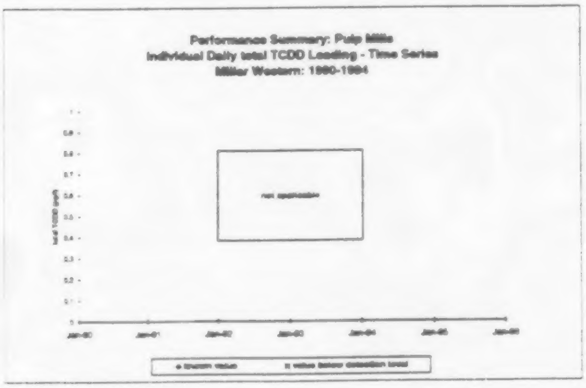

Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDD Loading - Time Series
Weyerhaeuser: 1990-1995


Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDD Loading - Time Series
Daishowa: 1990-1995

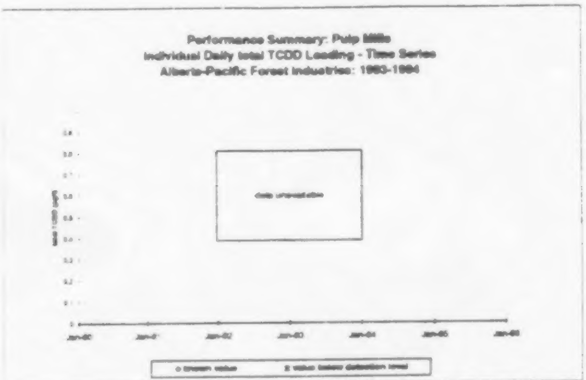
total tetrachlorodibenzo-p-dioxin (total TCDD) - pg/l

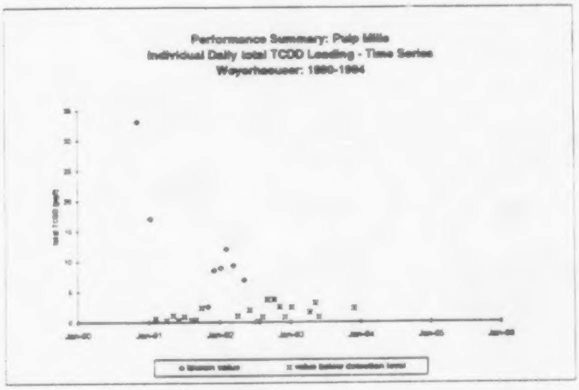


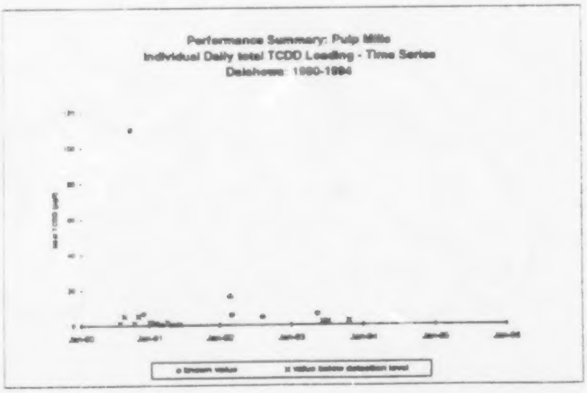




Performance Summary: Pulp Mills
Individual Daily total TCDD Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994
total TCDD (pg/l)
not applicable
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
◇ known value
x value below detection level



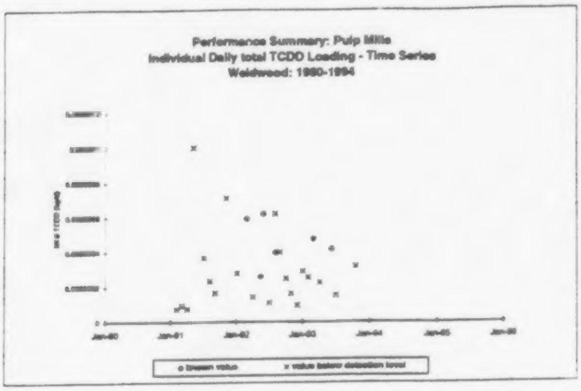


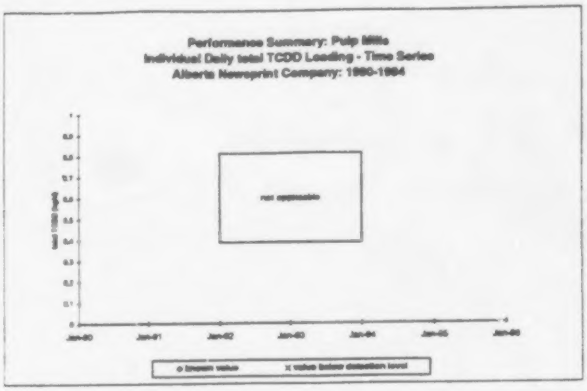


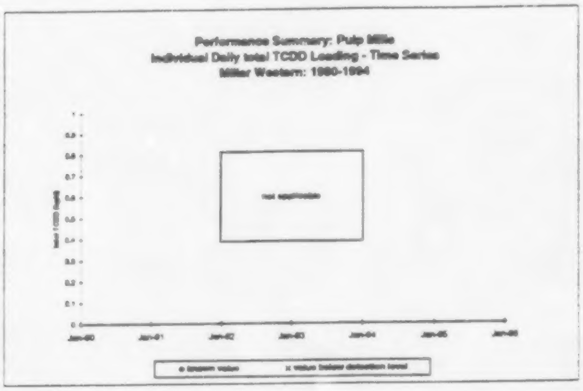
number of samples

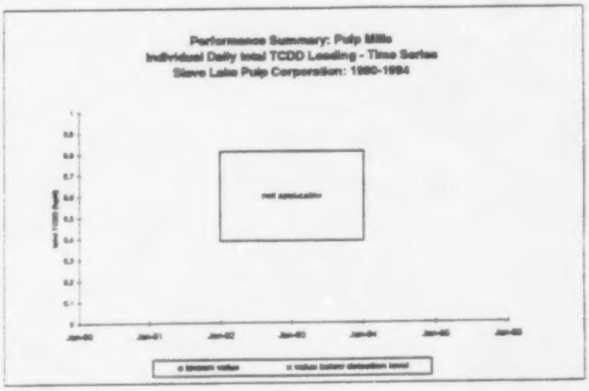
mill	above known detection level	below specified detection level	below unspecified detection level	total
Weldwood	6	21	1	28
ANC	0	0	0	0
Millar Western	n/a	n/a	n/a	n/a
Slave Lake	n/a	n/a	n/a	n/a
Al-Pac	n/a	n/a	n/a	n/a
Weyerhaeuser	8	21	0	29
Daishowa-Marubeni	6	13	18	37

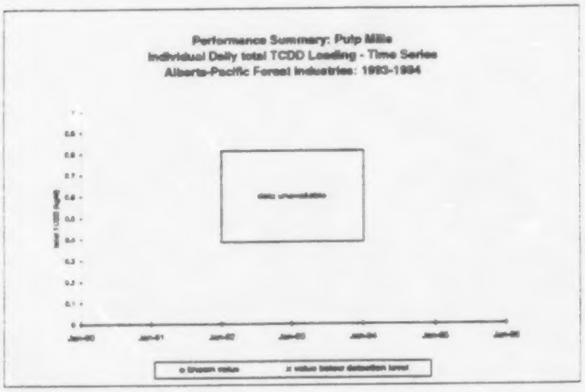
total tetrachlorodibenzo-p-dioxin (total TCDD) - kg/d

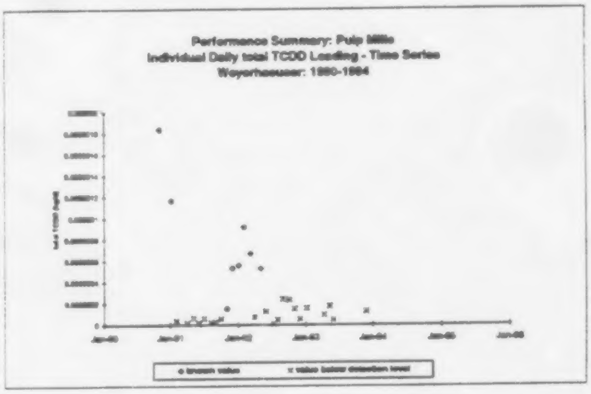


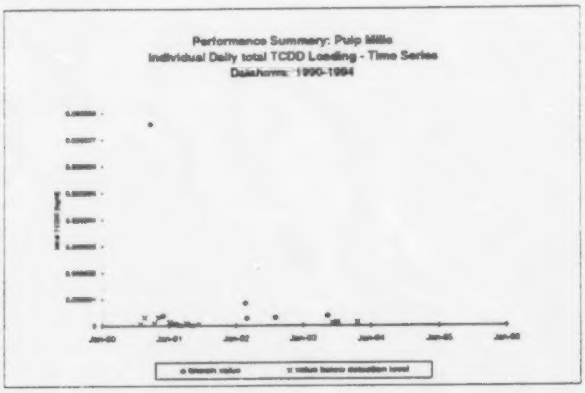




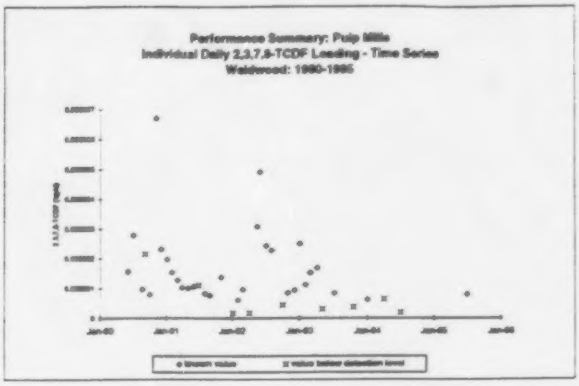


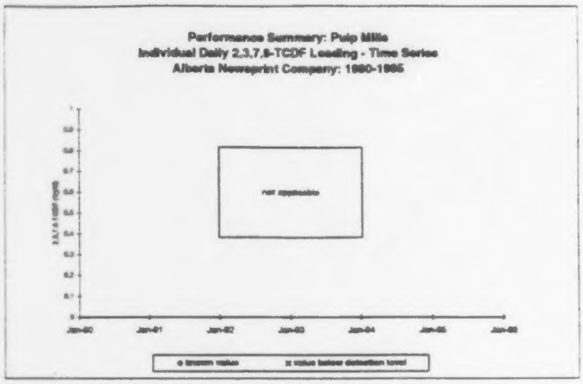


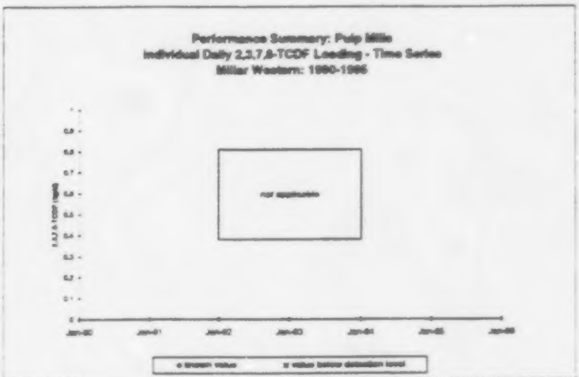


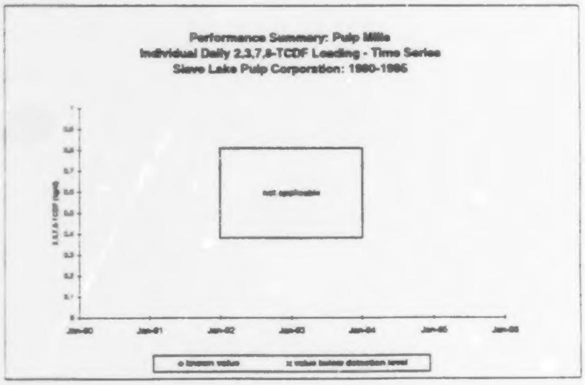


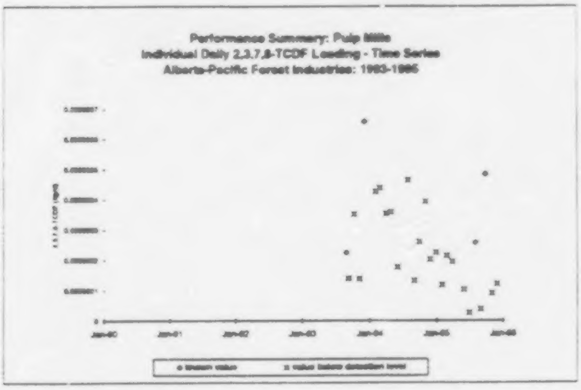
2,3,7,8-tetrachlorodibenzo-p-furan (2,3,7,8-TCDF) - kg/d

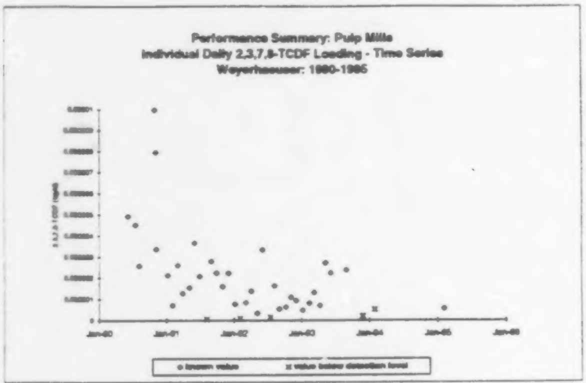

Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDF Loading - Time Series
Weldwood: 1990-1995

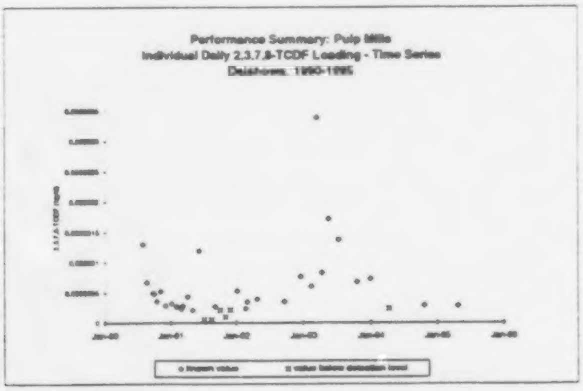

Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDF Loading - Time Series
Alberta Newsprint Company: 1990-1995


Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDF Loading - Time Series
Millar Western: 1990-1995

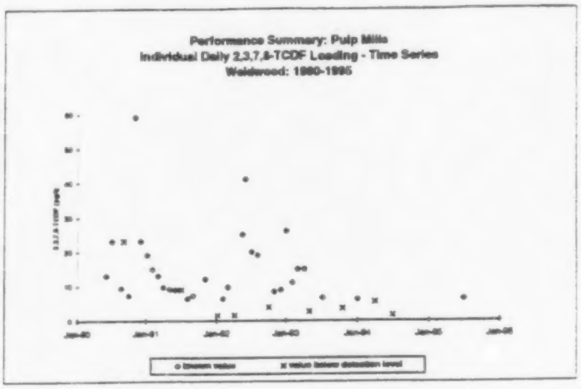

Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDF Loading - Time Series
Slave Lake Pulp Corporation: 1990-1995

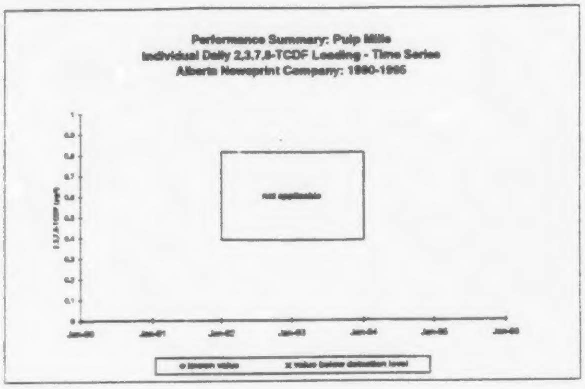

Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDF Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1995

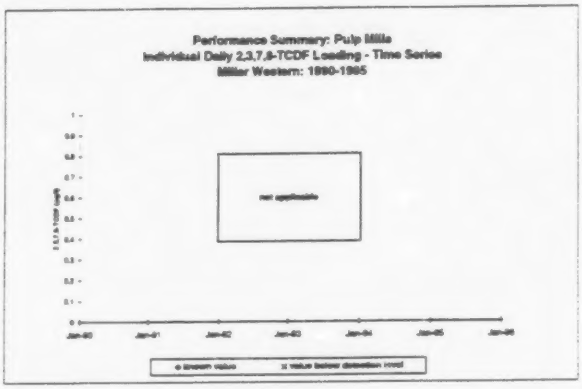

Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDF Loading - Time Series
Weyerhaeuser: 1990-1995

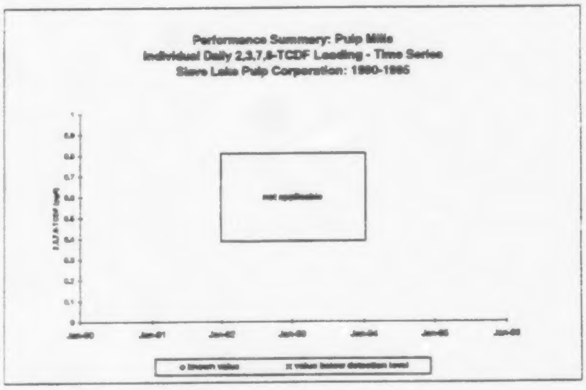

Performance Summary: Pulp Mills
Individual Daily 2,3,7,8-TCDF Loading - Time Series
Daishowa: 1990-1995

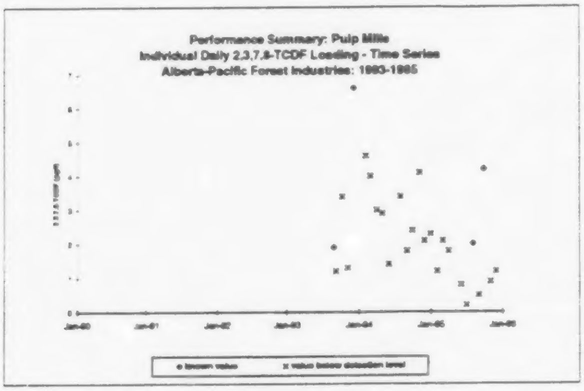
2,3,7,8-tetrachlorodibenzo-p-furan (2,3,7,8-TCDF) - pg/l

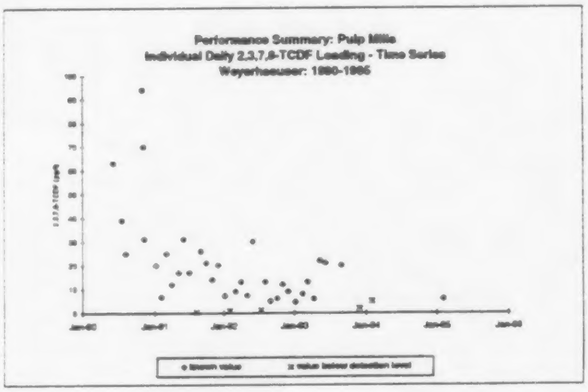


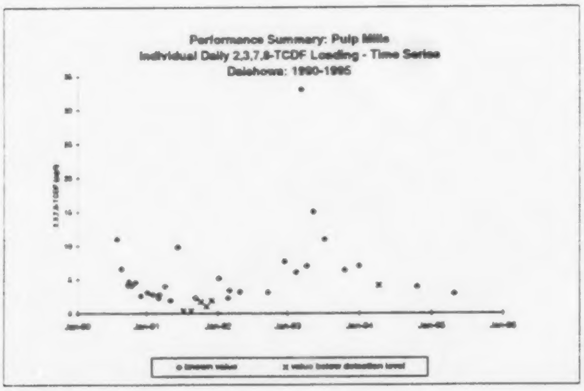










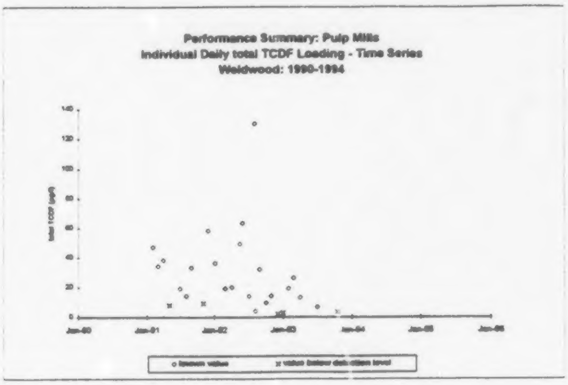


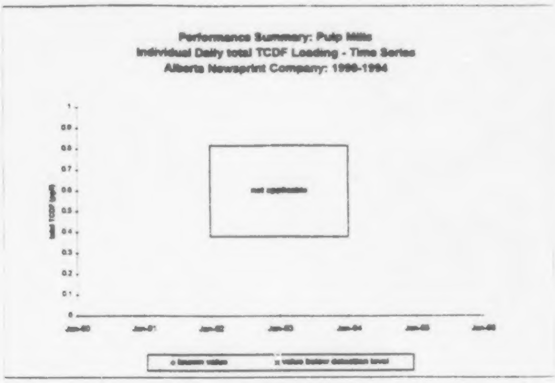
SUMMARY for 2,3,7,8-TCDF:

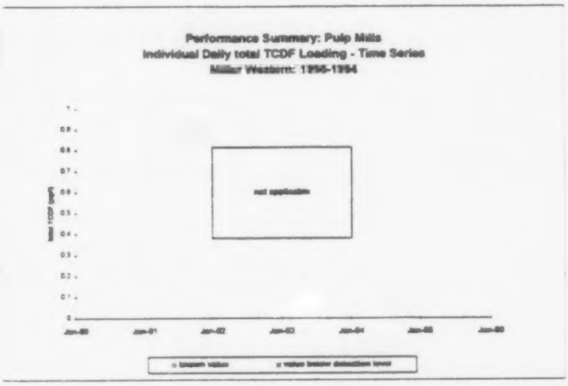
non-measurable detection level= 50 pg/l

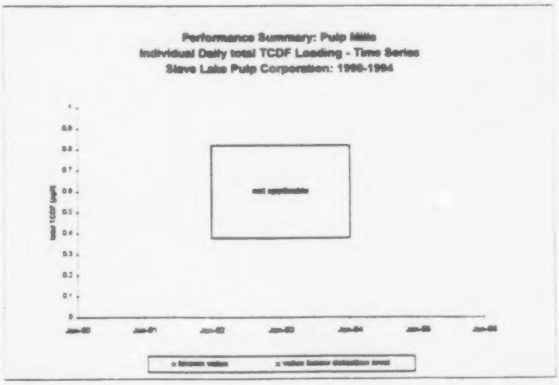
mill	values above known detection level	values below specified detection level	values below unspecified detection level	values above known detection level but below specified non-measurable level (1992-present)
Weldwood	30	9	0	15
ANC	n/a	n/a	n/a	n/a
Millar Western	n/a	n/a	n/a	n/a
Slave Lake	n/a	n/a	n/a	n/a
Al-Pac	4	22	0	4
Weyerhaeuser	35	5	0	18
Daishowa-Marubeni	30	6	0	15

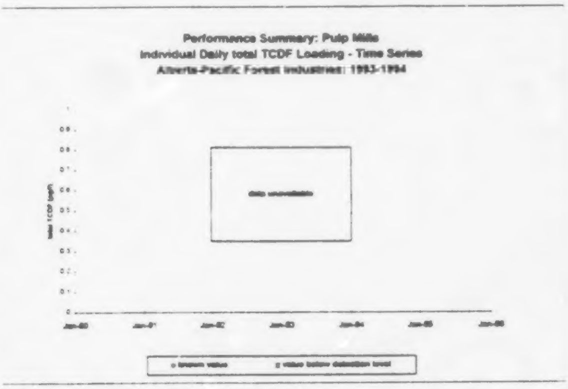
total tetralchlorodibenzo-p-furan (total TCDF) - pg/l

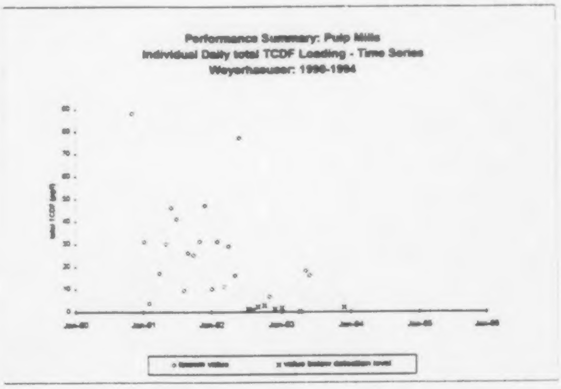

Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Weldwood: 1990-1994

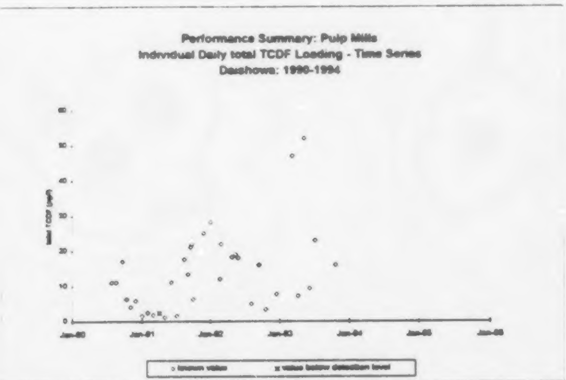

Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Alberta Newsprint Company: 1990-1994


Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Millar Western: 1990-1994


Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994


Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1994

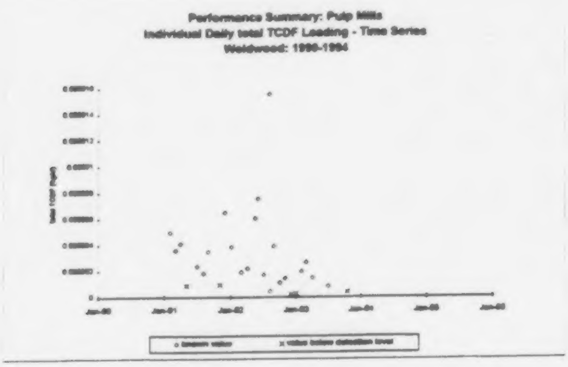

Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Weyerhaeuser: 1990-1994

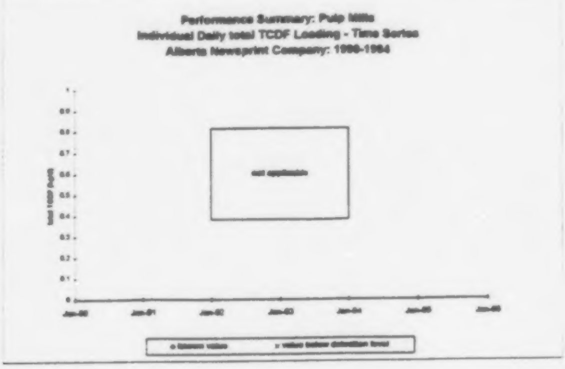

Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Daishowa: 1990-1994

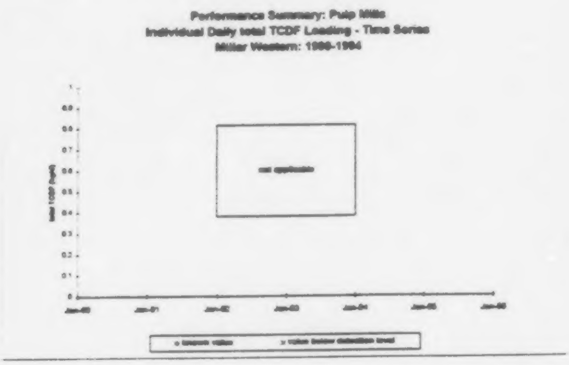
number of samples:

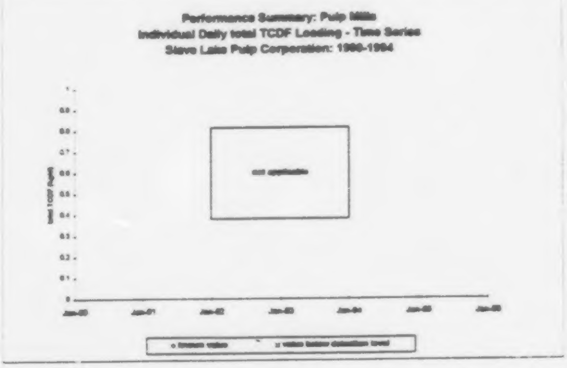
mill	above known detection level	below specified detection level	below unspecified detection level	total
Weldwood	22	5	1	28
ANC	n/a	n/a	n/a	n/a
Miller Western	n/a	n/a	n/a	n/a
Slave Lake	n/a	n/a	n/a	n/a
Al-Pac	0	0	0	0
Weyerhaeuser	21	8	0	29
Daishowa-Marubeni	34	1	4	39

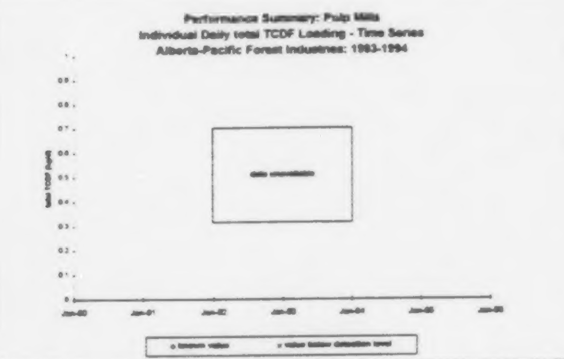
total tetralchlorodibenzo-p-furan (total TCDF) - kg/d

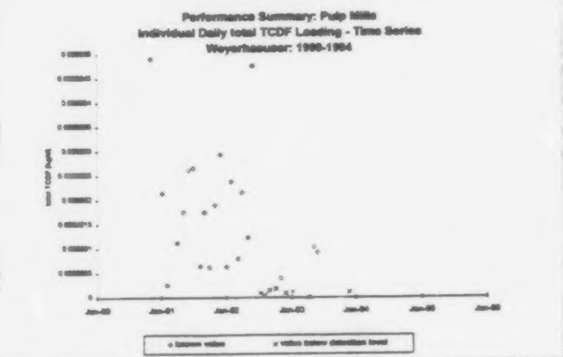

Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Weldwood: 1990-1994

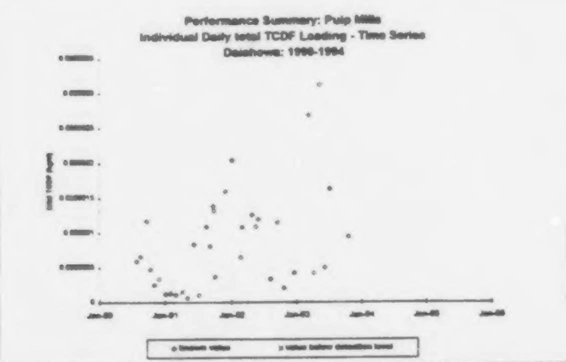

Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Alberta Newsprint Company: 1990-1994


Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Millar Western: 1990-1994

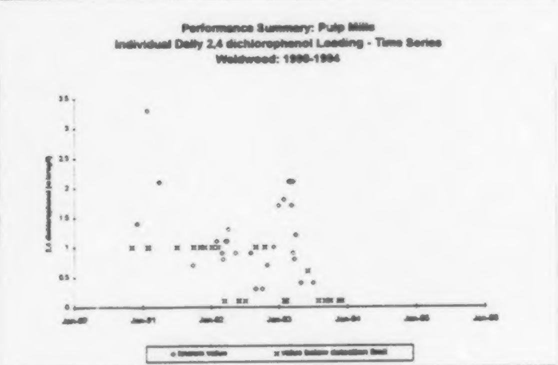

Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994

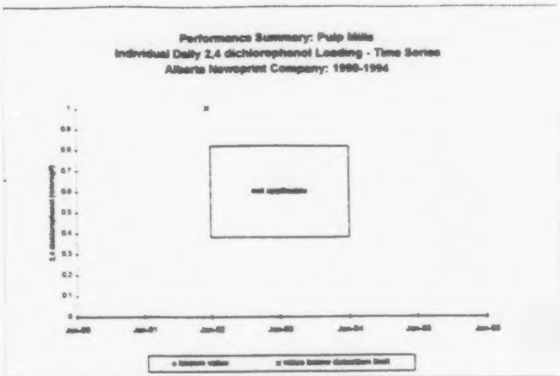

Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1994

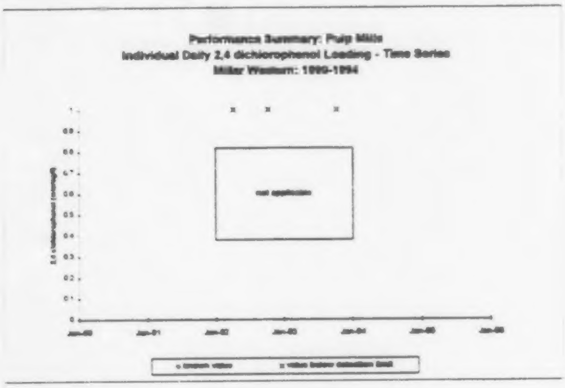

Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Weyerhaeuser: 1990-1994

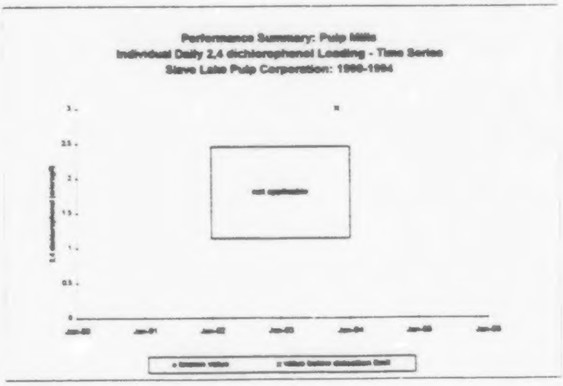

Performance Summary: Pulp Mills
Individual Daily total TCDF Loading - Time Series
Daishowa: 1990-1994

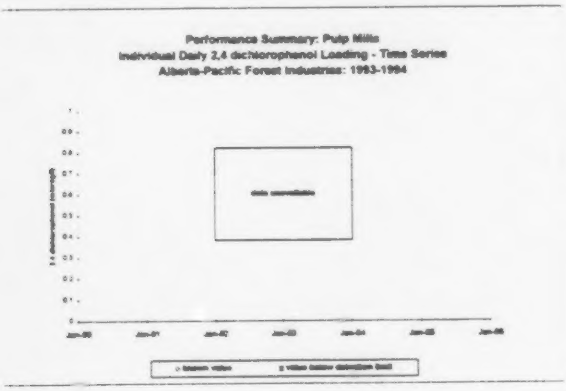
2,4 dichlorophenol (2,4 DCP) - microg/l

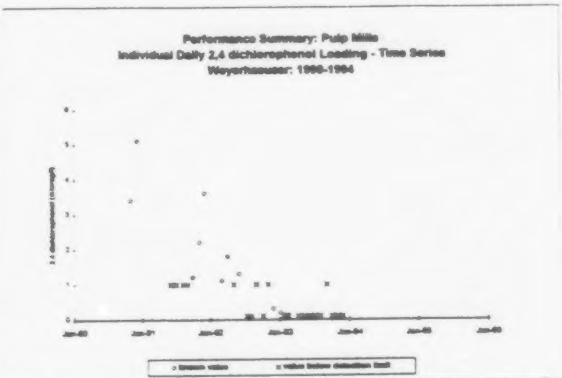


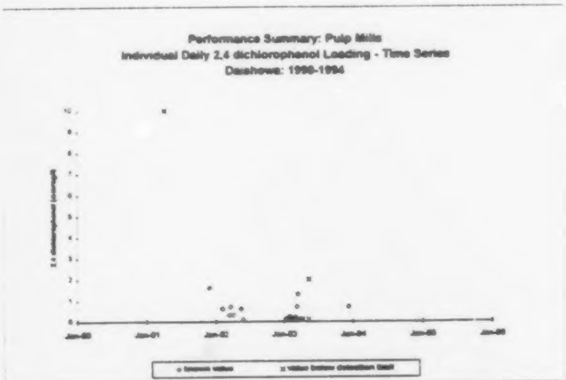






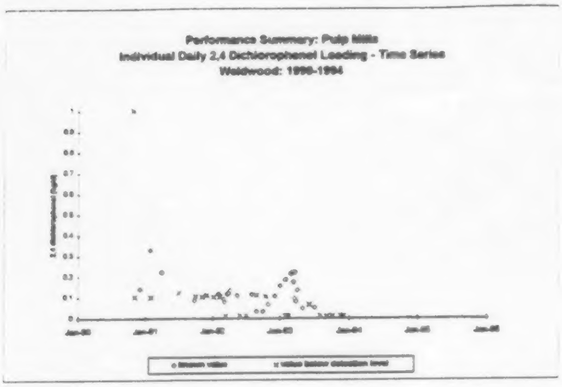


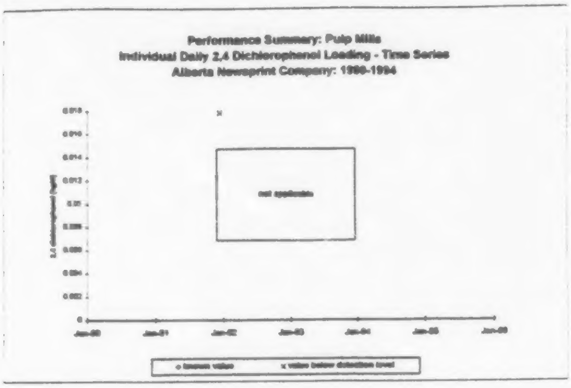


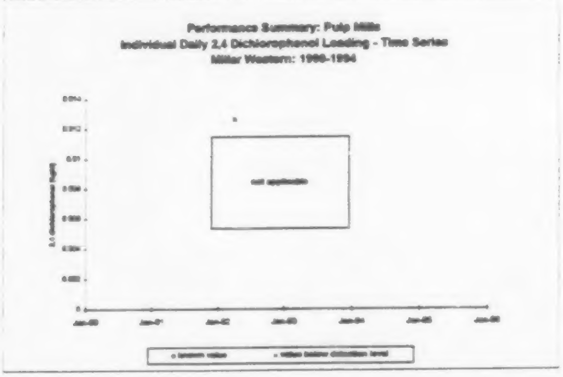


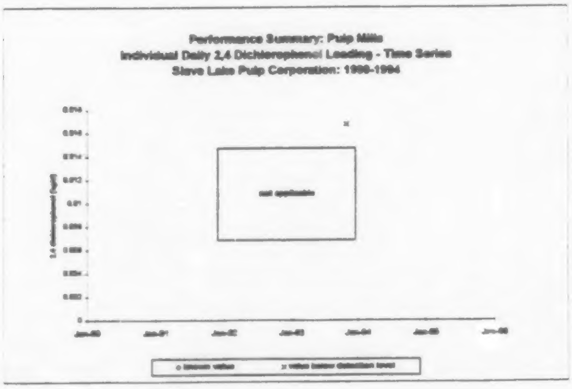
	number of samples			
mill	above known detection level	below specified detection level	below unspecified detection level	total
Weldwood	27	28	0	55
ANC	n/a	n/a	n/a	n/a
Millar Western	n/a	n/a	n/a	n/a
Slave Lake	n/a	n/a	n/a	n/a
Al-Pac	0	0	0	0
Weyerhaeuser	10	28	0	38
Daishowa-Marubeni	14	9	14	37

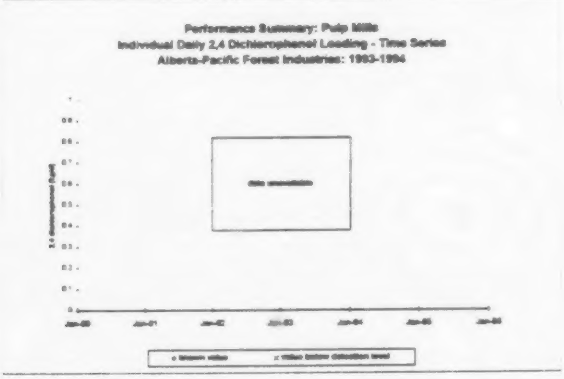
2,4 dichlorophenol (2,4 DCP) - kg/d

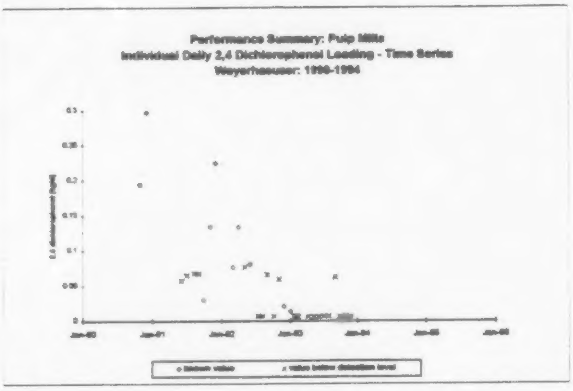


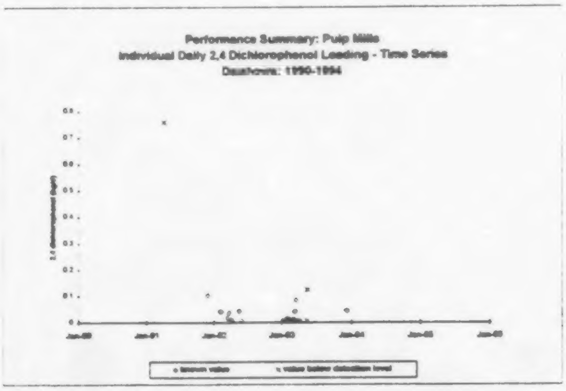




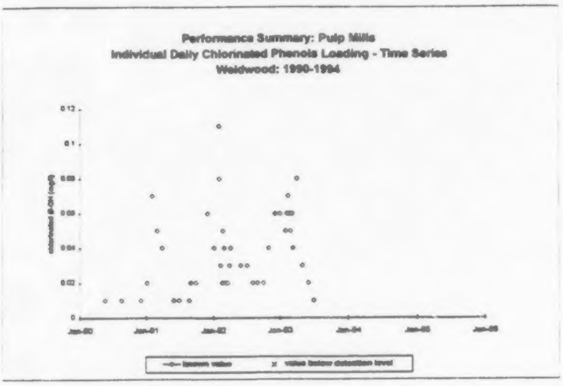


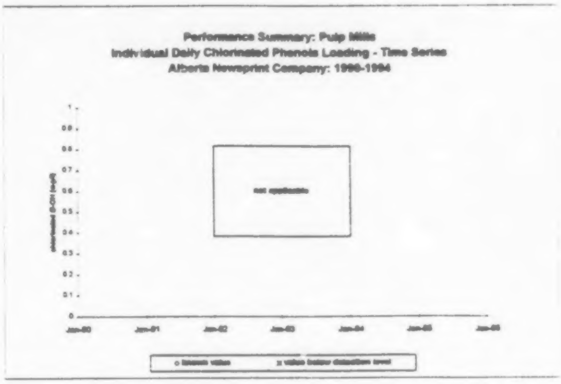


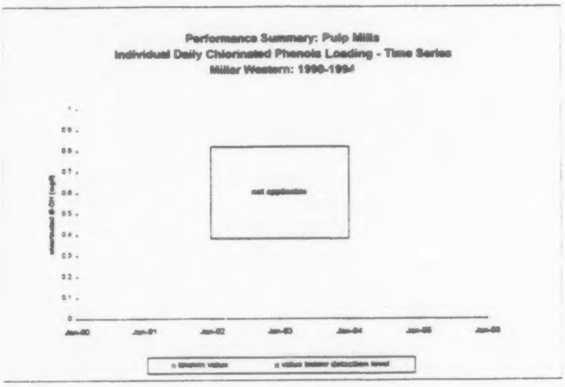


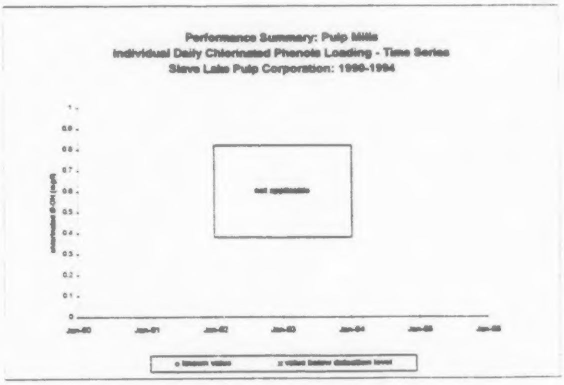


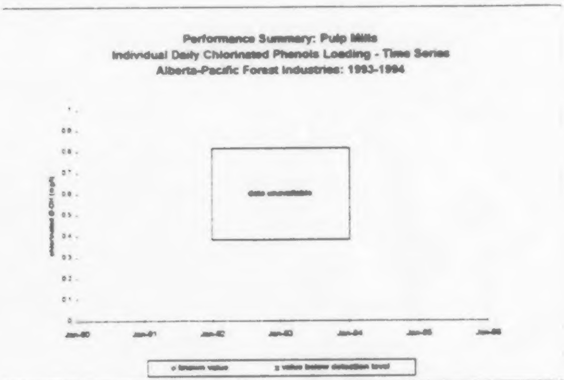
chlorinated phenols - mg/l

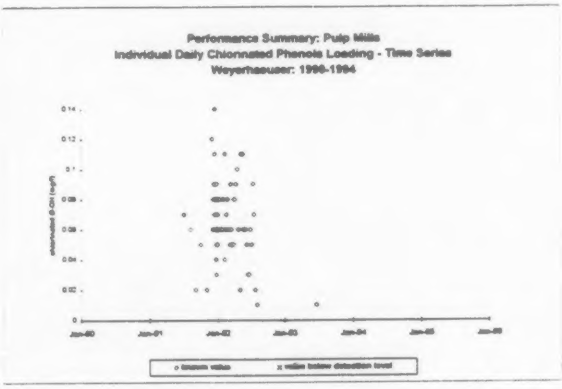

Performance Summary: Pulp Mills
Individual Daily Chlorinated Phenols Loading - Time Series
Weldwood: 1990-1994

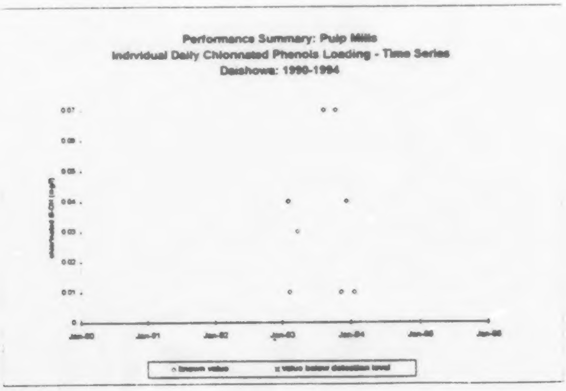

Performance Summary: Pulp Mills
Individual Daily Chlorinated Phenols Loading - Time Series
Alberta Newsprint Company: 1990-1994


Performance Summary: Pulp Mills
Individual Daily Chlorinated Phenols Loading - Time Series
Millar Western: 1990-1994


Performance Summary: Pulp Mills
Individual Daily Chlorinated Phenols Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994


Performance Summary: Pulp Mills
Individual Daily Chlorinated Phenols Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1994

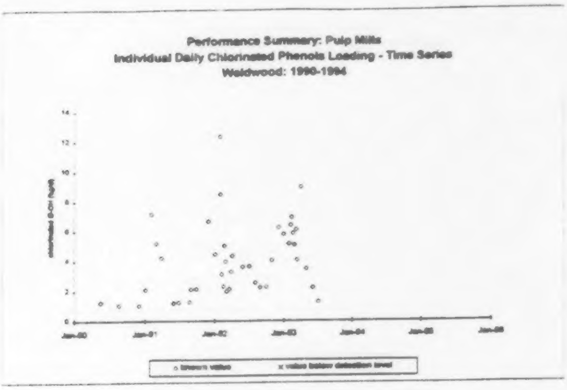

Performance Summary: Pulp Mills
Individual Daily Chlorinated Phenols Loading - Time Series
Weyerhaeuser: 1990-1994

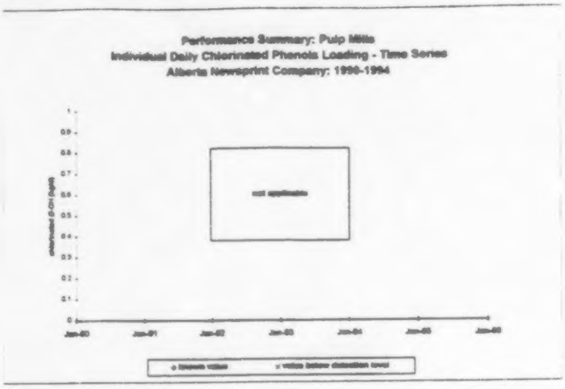

Performance Summary: Pulp Mills
Individual Daily Chlorinated Phenols Loading - Time Series
Daishowa: 1990-1994

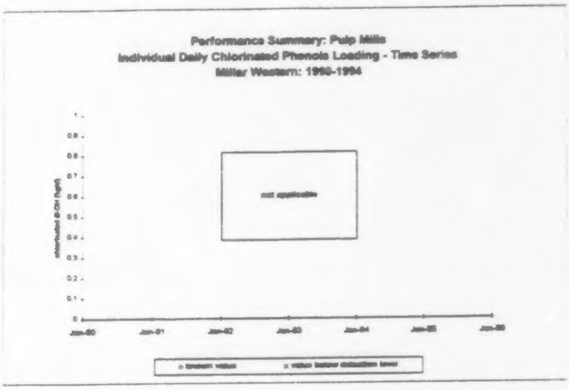
number of samples:

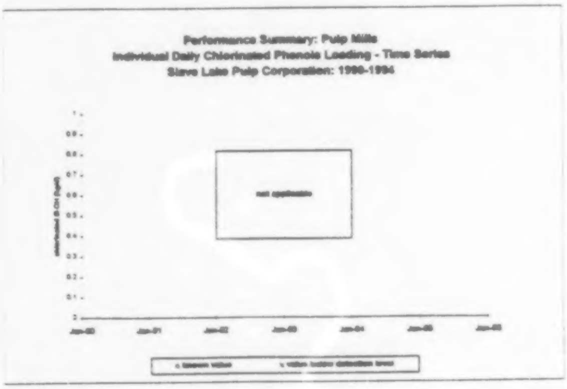
mill	above known detection limit	below specified detection limit	below unspecified detection limit	total
Weldwood	43	0	0	43
ANC	0	0	0	0
Millar Western	n/a	n/a	n/a	n/a
Slave Lake	n/a	n/a	n/a	n/a
Al-Pac	n/a	n/a	n/a	n/a
Weyerhaeuser	65	0	0	65
Daishowa-Marubeni	8	0	0	8

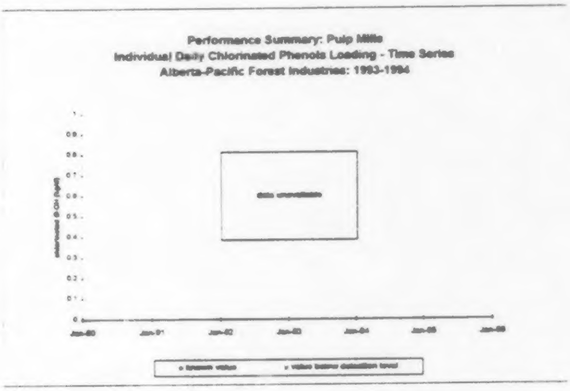
chlorinated phenols - kg/d

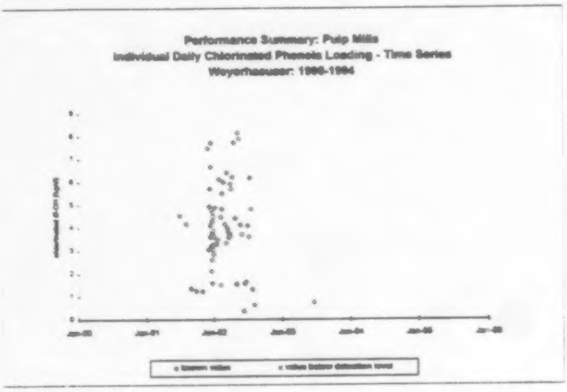


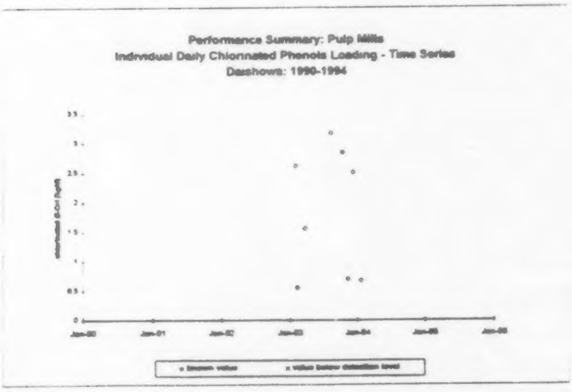








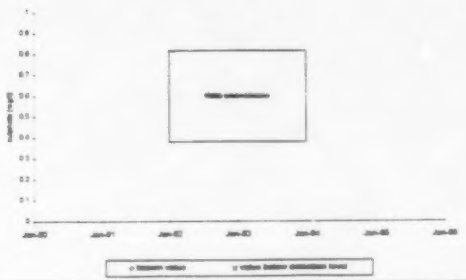




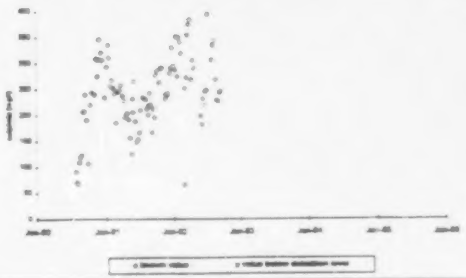
Others

sulphate - mg/l

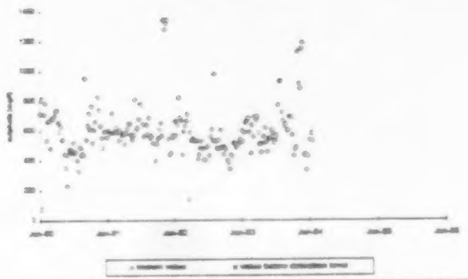
Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Weldwood: 1990-1994



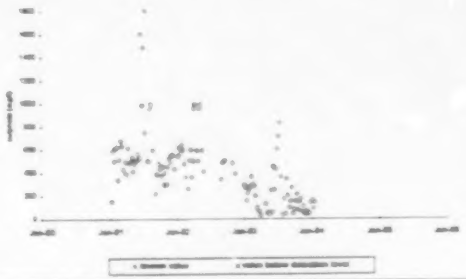
Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Alberta Newsprint Company: 1990-1994



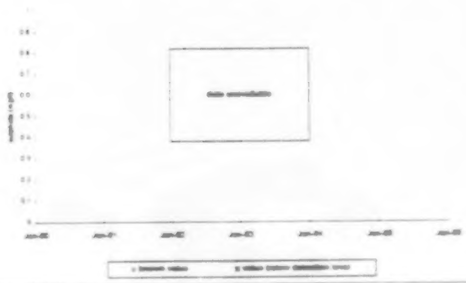
Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Millar Western: 1990-1994



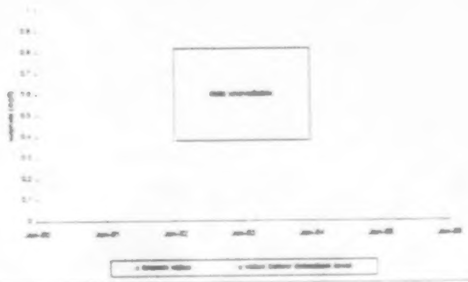
Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994



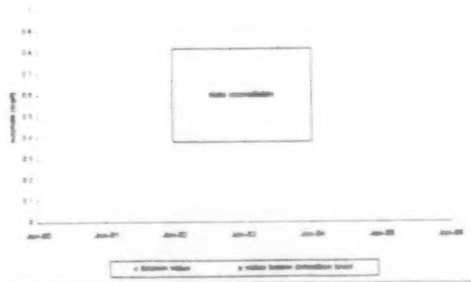
Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1994



Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Weyerhaeuser: 1990-1994



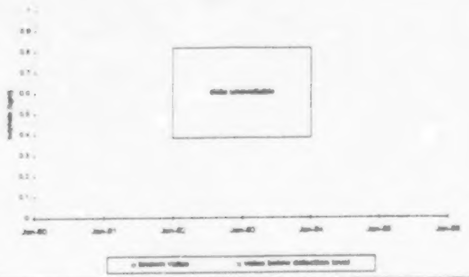
Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Daishowa: 1990-1994



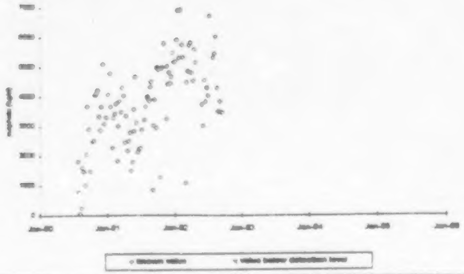
number of samples

mill	above known detection level	below specified detection level	below unspecified detection level	total
Weldwood	0	0	0	0
ANC	105	0	0	105
Millar Western	209	0	0	209
Slave Lake	130	0	0	130
Al-Pac	0	0	0	0
Weyerhaeuser	0	0	0	0
Daishowa-Marubeni	0	0	0	0

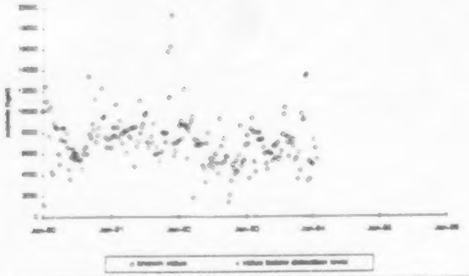
sulphate - kg/d



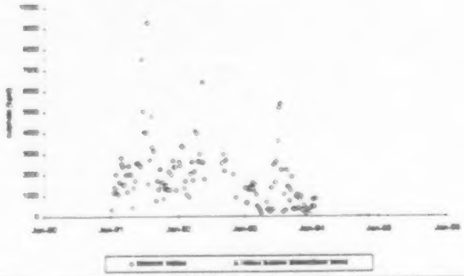
Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Weldwood: 1990-1994



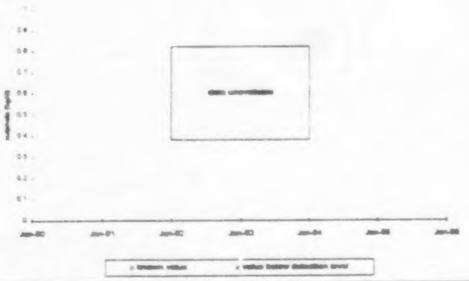
Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Alberta Newsprint Company: 1990-1994



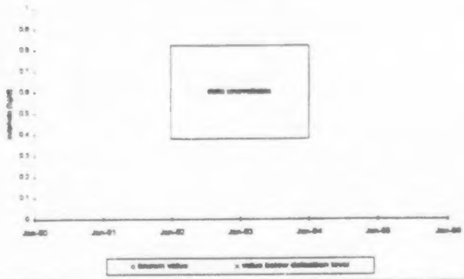
Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Millar Western: 1990-1994



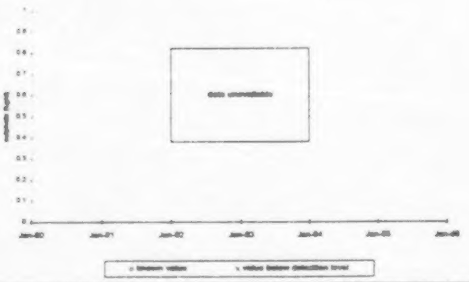
Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Slave Lake Pulp Corporation: 1990-1994



Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Alberta-Pacific Forest Industries: 1993-1994

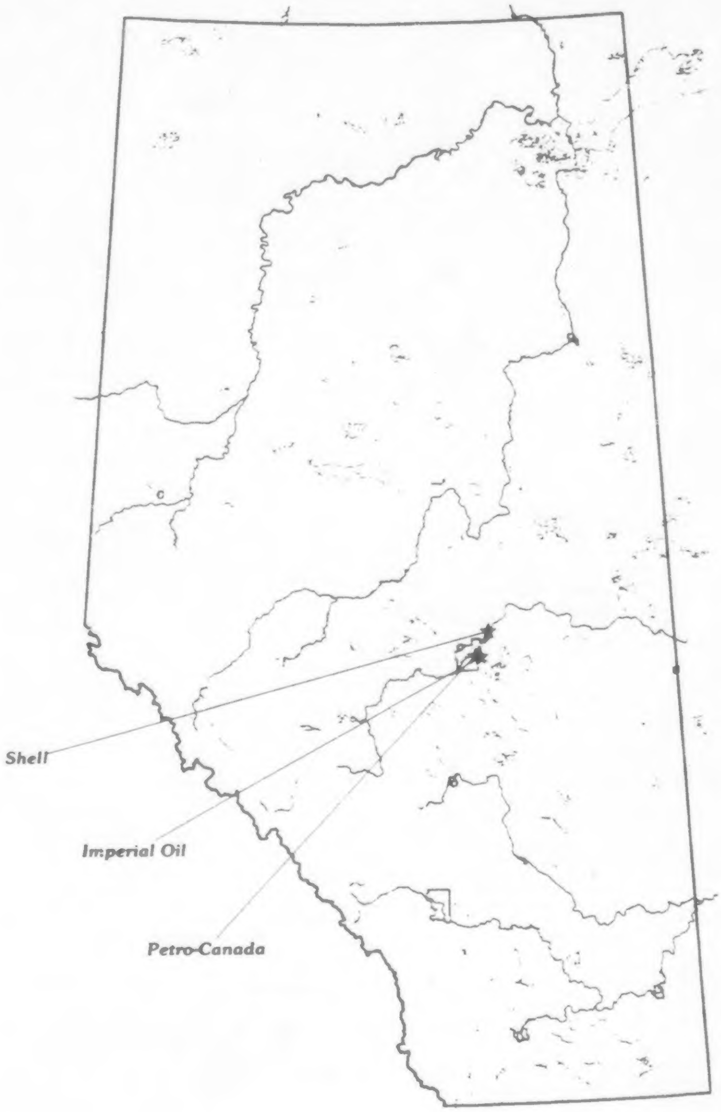


Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Weyerhaeuser: 1990-1994



Performance Summary: Pulp Mills
Individual Daily Sulphate Loading - Time Series
Daishowa: 1990-1994

Refineries


Shell
Imperial Oil
Petro-Canada

Refineries

General

There are currently nine refineries in Alberta, of which only three are approved for direct discharge. All of them are located on the North Saskatchewan River near Edmonton.

With a design capacity of 39600 m^3/d of western Canadian crude oil and a smaller amount of natural gas liquids, Imperial Oil's Strathcona Refinery is the largest refinery in Canada. At the Strathcona refinery, crude oil is refined into a variety of products such as gasoline, diesel fuel, liquified petroleum gases, wax, asphalt, jet fuel and lubricants. This refinery was built in 1948, and it is Imperial's supply source for all of western Canada and the north.

Petro-Canada's Edmonton refinery lies just to the north of the Strathcona Refinery and has a design capacity of 12300 m^3/d of conventional crude, 7380 m^3/d of synthetic crude and 1640 m^3/d of natural gas liquids. These raw petroleum starting materials are refined into a number of products such as propane, gasoline, middle distillate, bunker fuel oil, petroleum coke, sulphur and fuel gas.

Shell's Scotford refinery is the newest of Alberta's three directly discharging refineries. Only synthetic crude is processed at Scotford, up to a design capacity of 12408 m^3/d. Because only a single type of unrefined starting material is processed at Scotford, the refining process is simpler than that at both Imperial and Petro-Canada, thereby allowing Scotford to release a smaller effluent discharge than the two other facilities. Note that Shell employs intermittent discharge of effluent to the North Saskatchewan River via a lagoon - they do not practice continuous effluent release as do Imperial and Petro-Canada.

Refineries General Information

refinery	receiving stream	location	opened
Imperial	North Saskatchewan River	Edmonton	pre-1990
Petro-Canada	North Saskatchewan River	Edmonton	pre-1990
Shell	North Saskatchewan River	Scotford	pre-1990

Monitoring

Thirteen separate discharge monitoring requirements have been established for this sector, but only four of these, ammonia, phosphate TSS & flow were addressed in this report. These parameters are summarised in the following table:

Refineries Mandated Effluent Limits

refinery	parameter	1995 daily limit (kg/d)	1995 monthly limit (kg/d)
Imperial	ammonia-N	190	154
	phosphate	none	none
	TSS	791	634
Petro-Canada	ammonia-N	143	116
	phosphate	none	none
	TSS	596	477
Shell*	ammonia-N	85	69
	phosphate	none	none
	TSS	355	284

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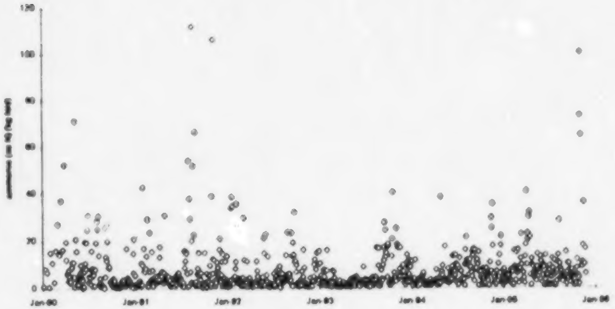
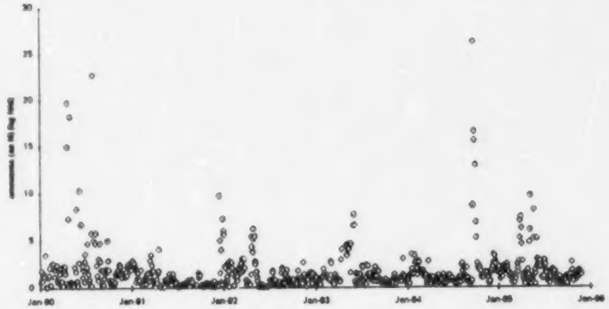
* batch operation

Ammonia

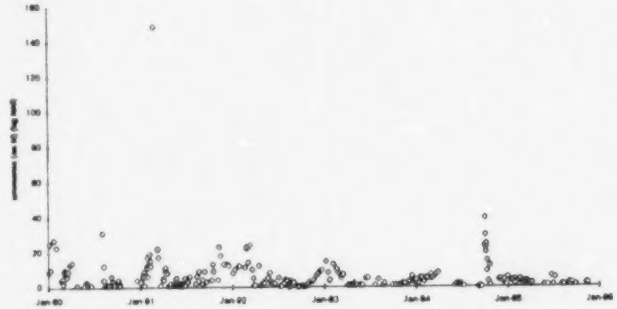
Performance Summary: Refineries
Individual Daily Ammonia Loading - Time Series
Imperial Oil, Strathcona Refinery: 1990-1995



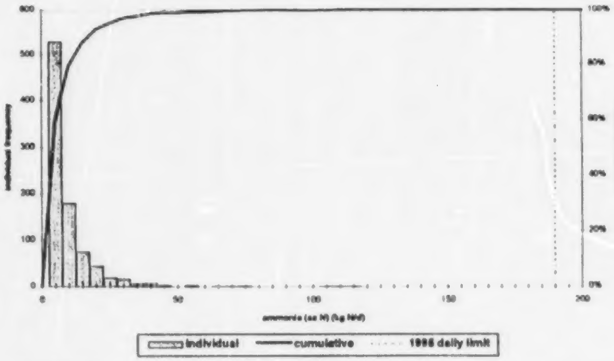
Performance Summary: Refineries
Individual Daily Ammonia Loading - Time Series
Petro-Canada Products, Edmonton Refinery: 1990-1995



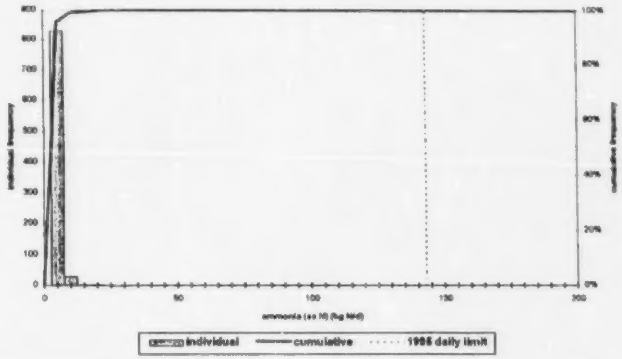
Performance Summary: Refineries
Individual Daily Ammonia Loading - Time Series
Shell Canada Products, Scotford Refinery: 1990-1995



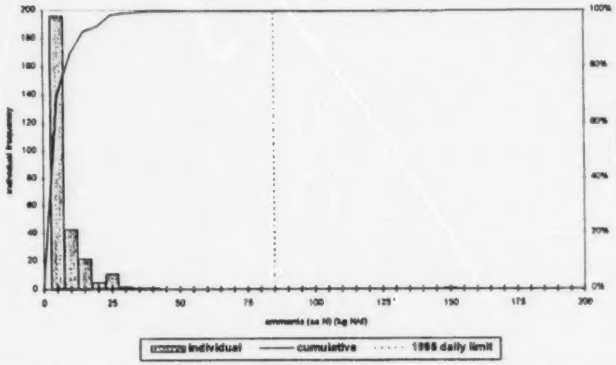
Performance Summary: Refineries
Individual Daily Ammonia Loading - Frequency Distribution
Imperial Oil, Strathcona Refinery: 1990-1995



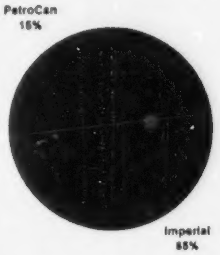
Performance Summary: Refineries
Individual Daily Ammonia Loading - Frequency Distribution
Petro-Canada Products, Edmonton Refinery: 1990-1995



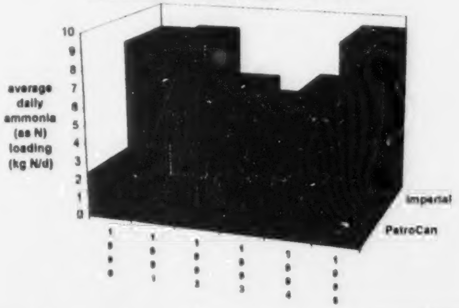
Performance Summary: Refineries
Individual Daily Ammonia Loading - Frequency Distribution
Shell Canada Products, Scotford Refinery: 1990-1995



Performance Summary: Refineries
Average Daily Ammonia (as N) Loading for 1995
non-batch facilities only
100% = 11.0 kg N/d aggregate ammonia loading



Performance Summary: Refineries
Annually Averaged Daily Ammonia Loading
non-batch facilities only ; 1990-1995



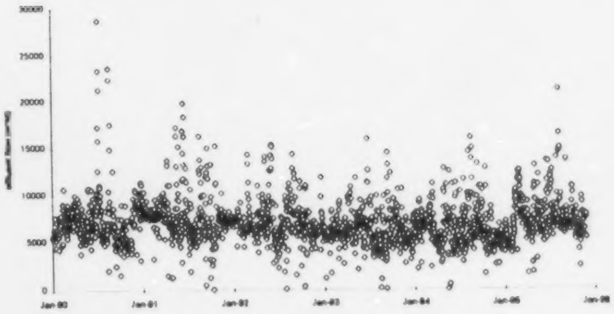
		aggregate (non-batch facilities only) (kg N/d):			
		Imperial	PetroCan	Shell	all
mode of operation:		continuous	continuous	batch	
total samples 1990-1995:		895	870	282	
average for:	1990	8.6	2.4		11.0
	1991	8.8	0.9		9.7
	1992	6.1	1.2		7.3
	1993	5.2	1.3		6.5
	1994	6.3	1.8		8.1
	1995	9.3	1.7		11.0
	1990-1995	7.3	1.6		8.9

ammonia (as N): calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

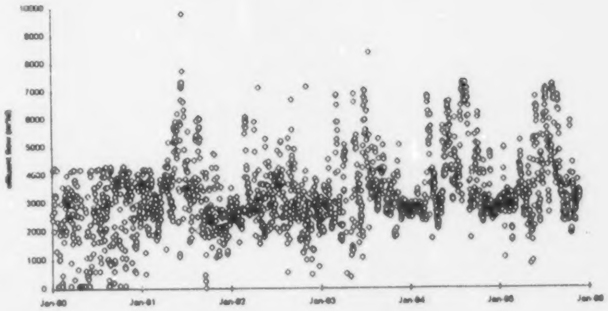
	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg N/d):	
refinery	x (kg N/d)	s (kg N/d)	x (kg N/d)	s (kg N/d)	x (kg N/d)	s (kg N/d)	x (kg N/d)	s (kg N/d)	x (kg N/d)	s (kg N/d)	x (kg N/d)	s (kg N/d)	daily	monthly
Imperial	8.6	10.6	8.8	15.4	6.1	7.8	5.2	6.3	6.3	6.3	9.3	12.5	190	154
Petro-Canada	2.4	3.5	0.9	1.3	1.2	1.2	1.3	1.3	1.8	3.0	1.7	1.6	143	116
Shell	6.4	7.3	8.7	18.8	4.7	5.8	3.5	3.4	7.4	9.4	2.6	1.4	85	69

Effluent Flow

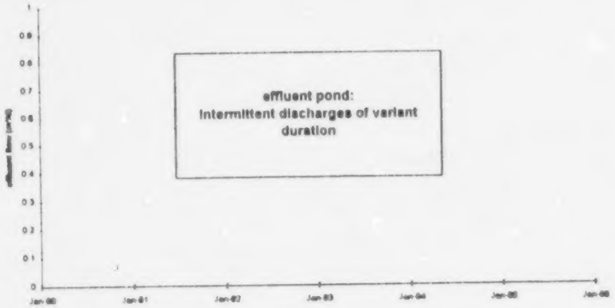
Performance Summary: Refineries
Individual Daily Effluent Flow - Time Series
Imperial Oil, Strathcona Refinery: 1990-1996



Performance Summary: Refineries
Individual Daily Effluent Flow - Time Series
Petro-Canada Products, Edmonton Refinery: 1990-1996

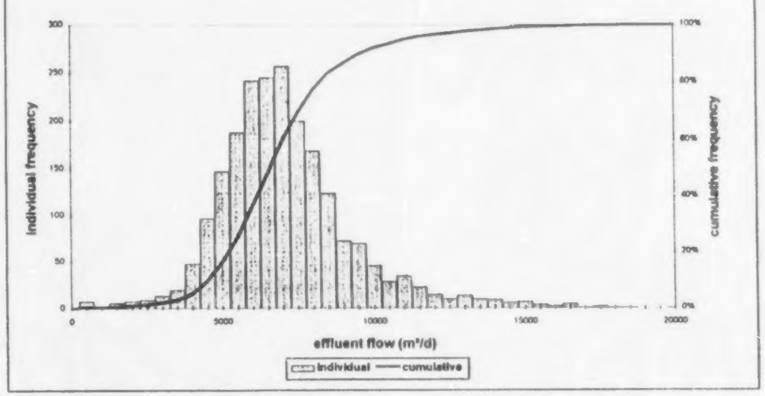


Performance Summary: Refineries
Individual Daily Effluent Flow - Time Series
Shell Canada Products, Scotford Refinery: 1990-1996

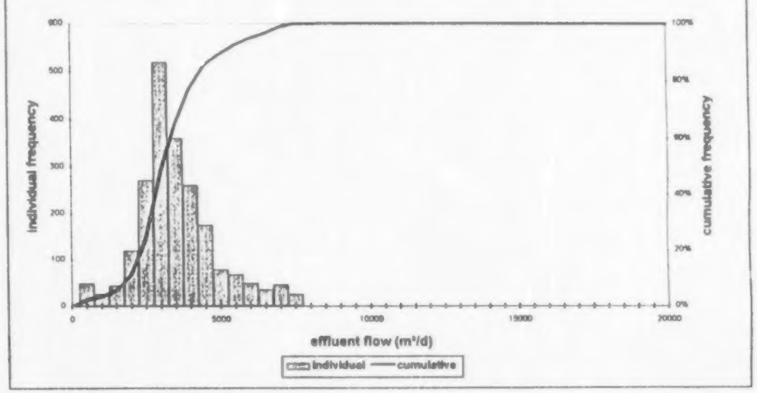


effluent pond:
Intermittent discharges of variant duration

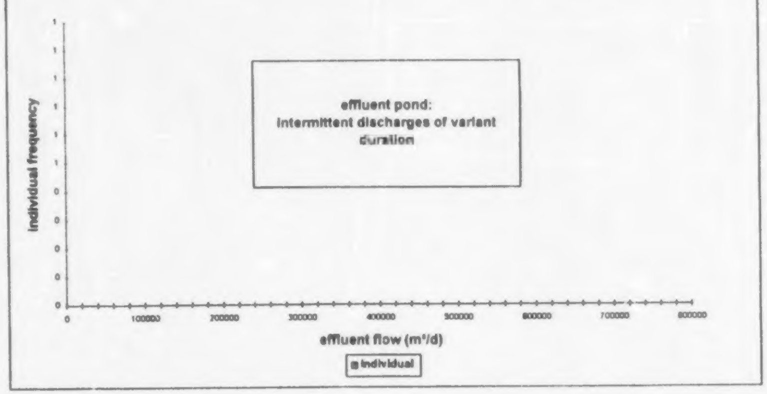
Performance Summary: Refineries
Individual Daily Effluent Flow - Frequency Distribution
Imperial Oil, Strathcona Refinery: 1990-1995



Performance Summary: Refineries
Individual Daily Effluent Flow - Frequency Distribution
Petro-Canada Products, Edmonton Refinery: 1990-1995

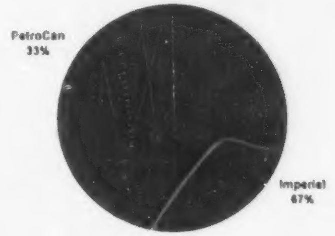


Performance Summary: Refineries
Individual Daily Effluent Flow - Frequency Distribution
Shell Canada Products, Scotford Refinery: 1990-1995

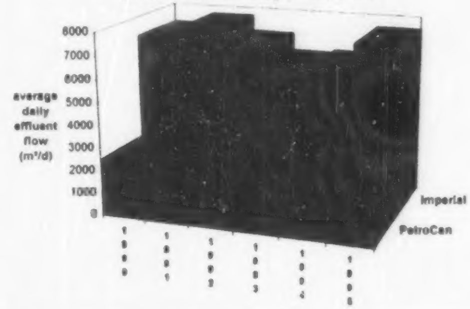


effluent pond:
intermittent discharges of variant duration

Performance Summary: Refineries
Average Daily Effluent Flow for 1995
non-batch facilities only
100% = 11133.4 m³/d aggregate effluent flow



Performance Summary: Refineries
Annually Averaged Daily Effluent Flow
non-batch facilities only ; 1990-1995



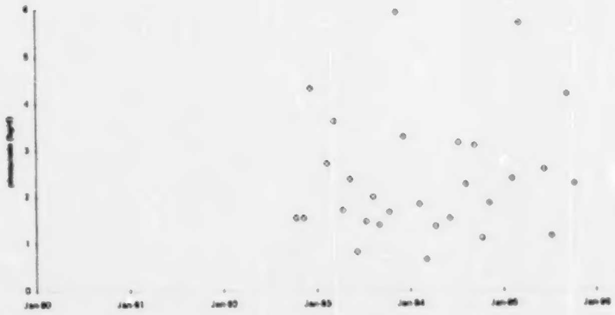
		aggregate (non-batch facilities only) (m³/d):			
		Imperial	PetroCan	Shell	all
mode of operation:		continuous	continuous	batch	
total samples 1990-1995:		2152	2139	0	
average for:	1990	7153.1	2501.5		9654.6
	1991	7630.3	3318.9		10949.2
	1992	6915.6	2961.7		9877.3
	1993	6140.6	3343.0		9483.6
	1994	6253.0	3825.4		10078.4
	1995	7436.2	3697.3		11133.4
	1990-1995	6915.2	3269.3		10184.5

effluent flow (m³/d): calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

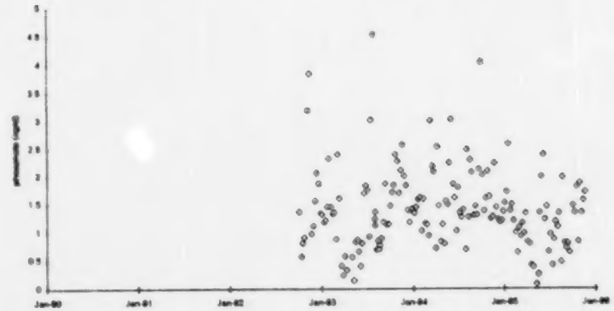
	1990		1991		1992		1993		1994		1995		1995 imposed limits (m³/d):	
refinery	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	daily	monthly
Imperial	7153.1	2865.2	7630.3	2594.4	6915.6	2165.5	6140.6	1955.5	6253.0	2231.3	7436.2	2347.5	-	-
Petro-Canada	2501.5	1312.3	3318.9	1358.9	2961.7	988.9	3343.0	1201.3	3825.4	1381.4	3697.3	1353.6	-	-
Shell	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Phosphate

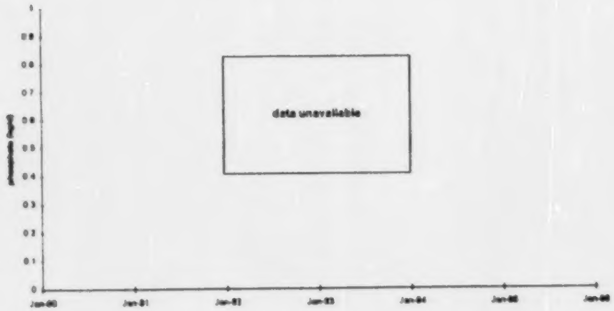
Performance Summary: Refineries
Individual Daily Phosphate Loading - Time Series
Imperial Oil, Strathcona Refinery: 1990-1995



Performance Summary: Refineries
Individual Daily Phosphate Loading - Time Series
Petro-Canada Products, Edmonton Refinery: 1990-1995



Performance Summary: Refineries
Individual Daily Phosphate Loading - Time Series
Shell Canada Products, Scotford Refinery: 1990-1995



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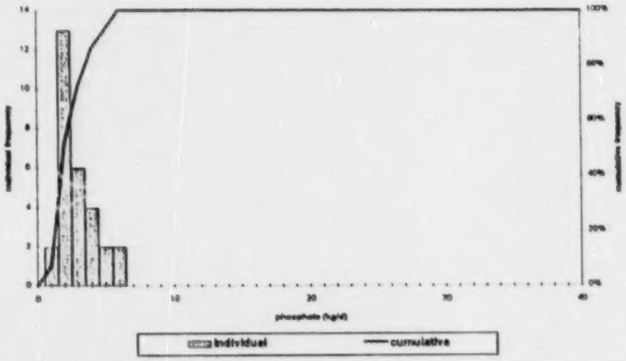
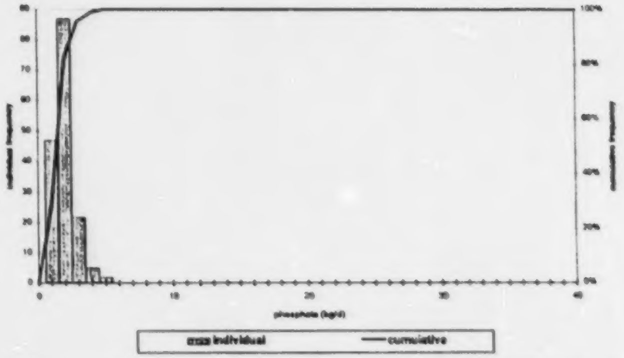
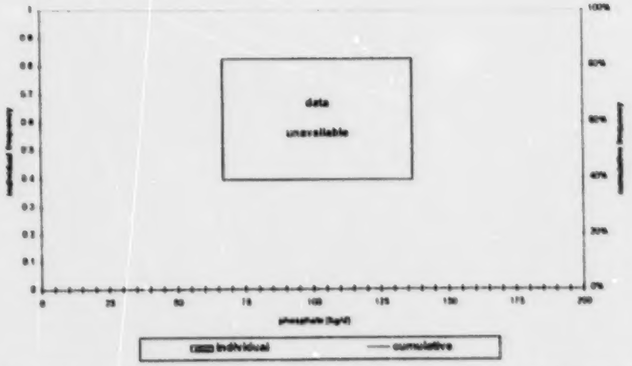
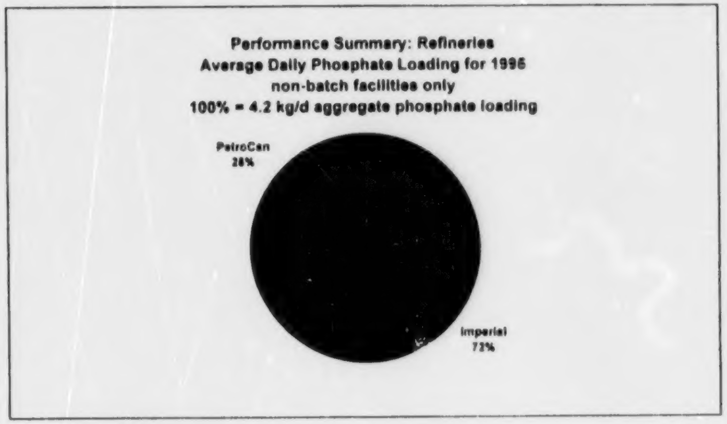
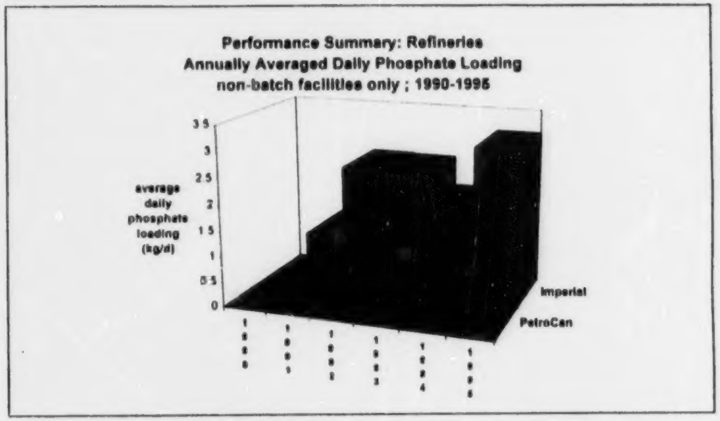

Performance Summary: Refineries
Individual Daily Phosphate Loading - Frequency Distribution
Imperial Oil, Strathcona Refinery: 1990-1995


Performance Summary: Refineries
Individual Daily Phosphate Loading - Frequency Distribution
Petro-Canada Products, Edmonton Refinery: 1990-1995


Performance Summary: Refineries
Individual Daily Phosphate Loading - Frequency Distribution
Shell Canada Products, Scotford Refinery: 1990-1995


Performance Summary: Refineries
Average Daily Phosphate Loading for 1995
non-batch facilities only
100% = 4.2 kg/d aggregate phosphate loading


Performance Summary: Refineries
Annually Averaged Daily Phosphate Loading
non-batch facilities only ; 1990-1995

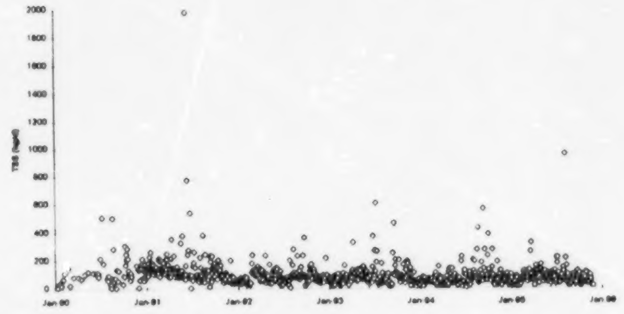
		aggregate (non-batch facilities only) (kg/d):			
		Imperial	PetroCan	Shell	all
mode of operation:		continuous	continuous	batch	
total samples 1990-1995:		29	163	0	
average for:	1990	-	-		0.0
	1991	-	-		0.0
	1992	2.5	1.6		4.1
	1993	2.4	1.4		3.8
	1994	1.9	1.6		3.5
	1995	3.0	1.2		4.2
	1990-1995	2.4	1.4		3.8

phosphate: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

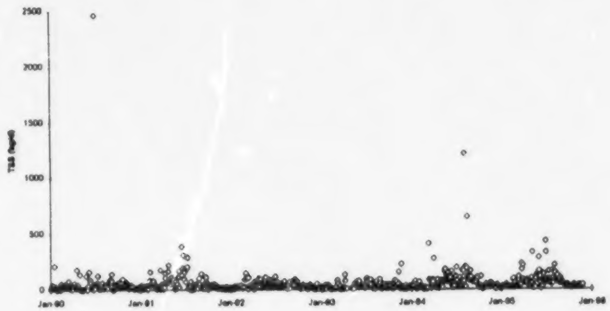
	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
refinery	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Imperial	-	-	-	-	2.5	1.8	2.4	1.4	1.9	0.8	3.0	1.6	none	none
Petro-Canada	-	-	-	-	1.6	1.0	1.4	0.6	1.6	0.6	1.2	0.5	none	none
Shell	-	-	-	-	-	-	-	-	-	-	-	-	none	none

Total Suspended Solids
(TSS)

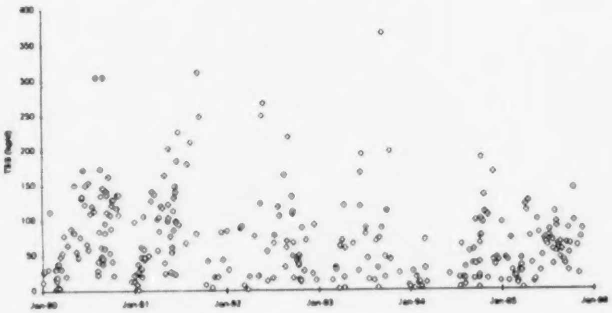
Performance Summary: Refineries
Individual Daily TSS Loading - Time Series
Imperial Oil, Strathcona Refinery: 1990-1995



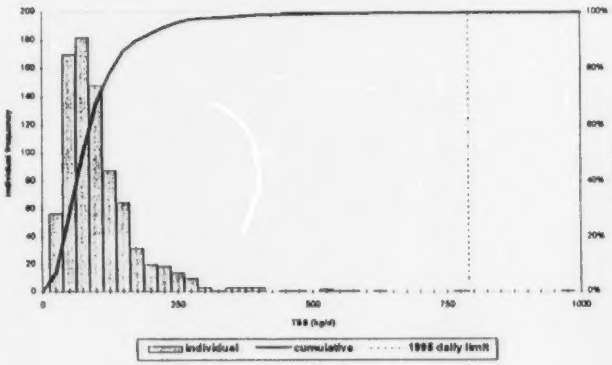
Performance Summary: Refineries
Individual Daily TSS Loading - Time Series
Petro-Canada Products, Edmonton Refinery: 1990-1995



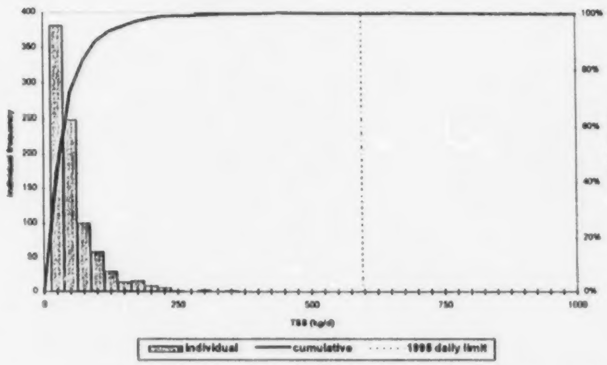
Performance Summary: Refineries
Individual Daily TSS Loading - Time Series
Shell Canada Products, Scotford Refinery: 1990-1995



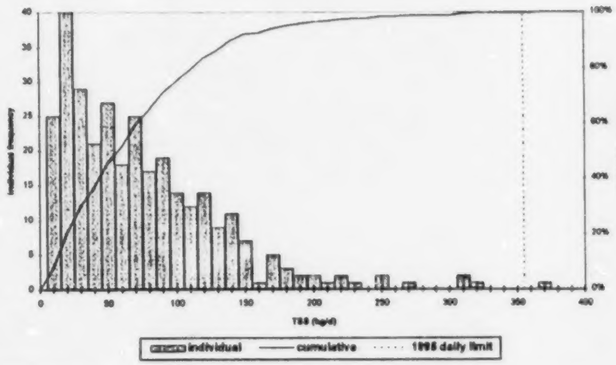
Performance Summary: Refineries
Individual Daily TSS Loading - Frequency Distribution
Imperial Oil, Strathcona Refinery: 1990-1995



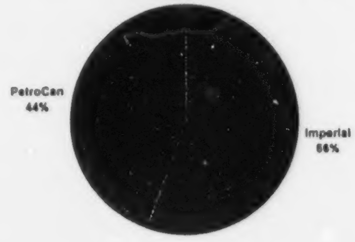
Performance Summary: Refineries
Individual Daily TSS Loading - Frequency Distribution
Petro-Canada Products, Edmonton Refinery: 1990-1995



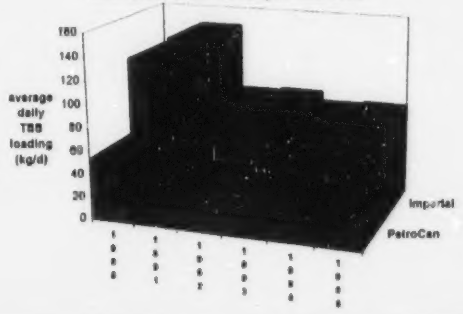
Performance Summary: Refineries
Individual Daily TSS Loading - Frequency Distribution
Shell Canada Products, Scotford Refinery: 1990-1995



Performance Summary: Refineries
Average Daily TSS Loading for 1995
non-batch facilities only
100% = 145.2 kg/d aggregate TSS loading



Performance Summary: Refineries
Annually Averaged Daily TSS Loading
non-batch facilities only ; 1990-1995

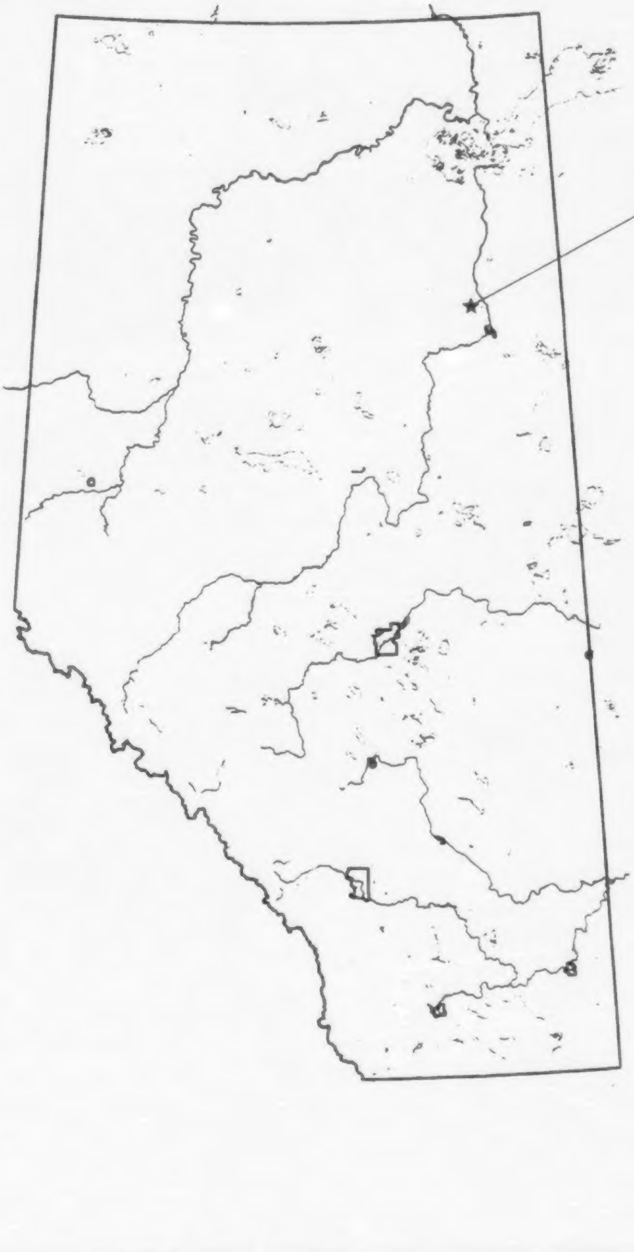


	aggregate (non-batch facilities only) (kg/d):			
	Imperial	PetroCan	Shell	all
mode of operation:	continuous	continuous	batch	
total samples 1990-1995:	828	881	312	
average for: 1990	123.0	54.1		177.1
1991	143.9	50.9		194.9
1992	86.1	36.3		122.4
1993	87.6	29.5		117.0
1994	79.3	65.7		145.0
1995	81.0	64.3		145.2
1990-1995	98.0	49.9		147.9

TSS: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1996 imposed limits (kg/d):	
refinery	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Imperial	122.98	97.18	143.95	174.58	86.11	63.66	87.57	77.38	79.31	75.19	80.95	88.83	791	634
Petro-Canada	54.11	216.95	50.94	63.47	36.29	27.12	29.47	30.82	65.73	118.31	64.28	66.58	596	477
Shell	80.31	62.42	89.27	68.15	70.64	61.44	69.70	74.97	46.54	44.80	58.07	32.54	355	284

Tar Sands Plants



Tar Sands Plants

General

This sector comprises two distinct groups, an *in situ* recovery group, and a mine extraction group. The *in situ* group includes approximately sixty mostly[*] small-scale facilities scattered throughout northern Alberta. Some of these facilities are inactive or are being phased out, while a few are currently engaged in pilot-scale, enhanced-recovery research into the application of steam injection as a means of minimizing water use and disposal requirements. With the exception of the few enhanced recovery facilities, these facilities release no wastewater to receiving watercourses, though some do produce solid waste in the form of lime sludges. The mine extraction group includes two very large facilities, Syncrude and Suncor. These two plants are the most established and successful exponents of oilsands extraction technology in the world today.

Neither of these plants currently releases a significant quantity of process wastewater to the environment. Suncor has approval for direct discharge to the Athabasca River (and is in fact the only tar sands extraction facility in the province that has such approval), but their wastewater effluent typically includes very little process water, containing instead mostly non-process water and sanitary sewage. Syncrude currently releases no wastewater discharge at all. These facilities have been able to attain such low effluent discharges through the use of massive containment ponds. Research into treatment and disposal of the accumulated process water and sludges is continuing at both Suncor and Syncrude.

Tar Sands Plants General Information

plant	receiving stream	location	opened
Suncor	Athabasca River	Fort McMurray	pre-1990

Monitoring

Fifteen separate discharge monitoring requirements have been defined for this sector, of which seven are included in this report: ammonia-N, phenols, sulphide, COD, TSS, oil & grease, and flow. The imposed effluent discharge limits for each of these plants is summarized in the following table:

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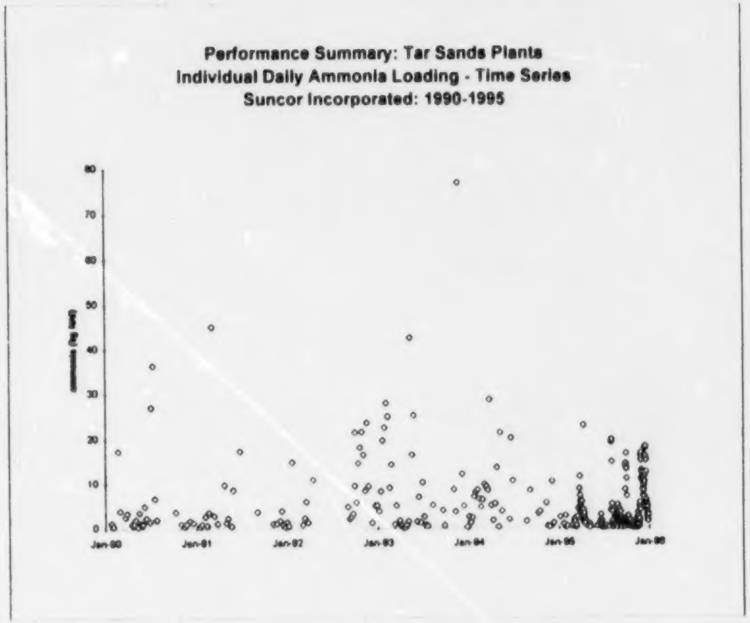
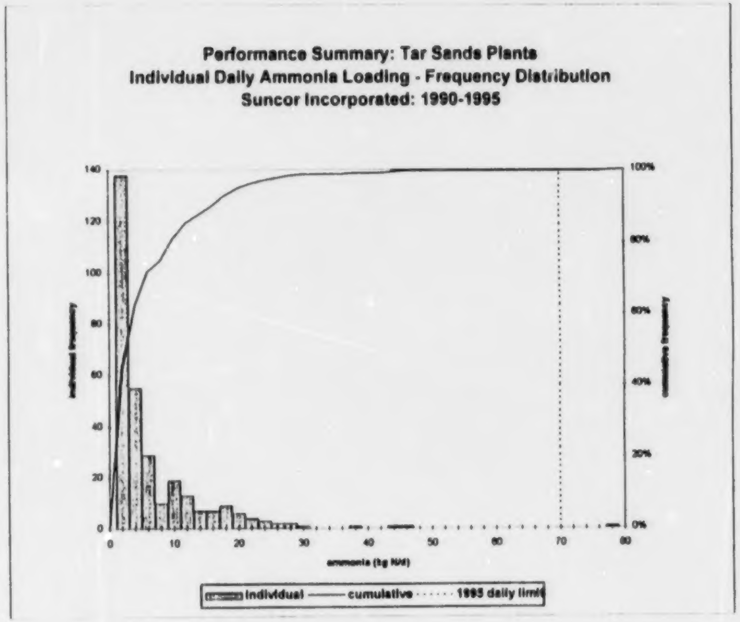
[*] For instance, Esso's enhanced recovery mine-extraction plant at Cold Lake is actually very large.

Tar Sands Plants Mandated Effluent Limits

plant	parameter	1995 daily limit (kg/d)	1995 monthly limit (kg/d)
Suncor	ammonia-N	70	25
	phenols	5	2
	sulphide	7	3.8
	COD	3000	1200
	TSS	1500	1000
	oil & grease	300	150

Ammonia

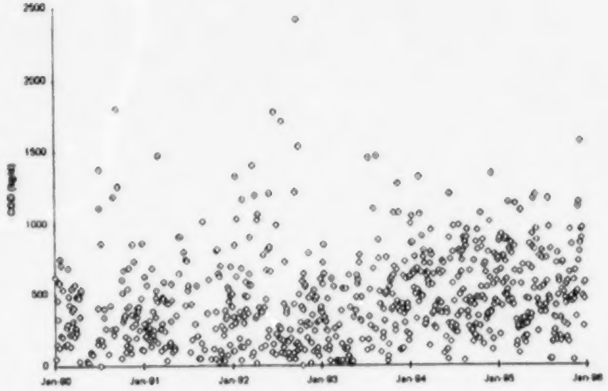

Performance Summary: Tar Sands Plants
Individual Daily Ammonia Loading - Time Series
Suncor Incorporated: 1990-1995


Performance Summary: Tar Sands Plants
Individual Daily Ammonia Loading - Frequency Distribution
Suncor Incorporated: 1990-1995

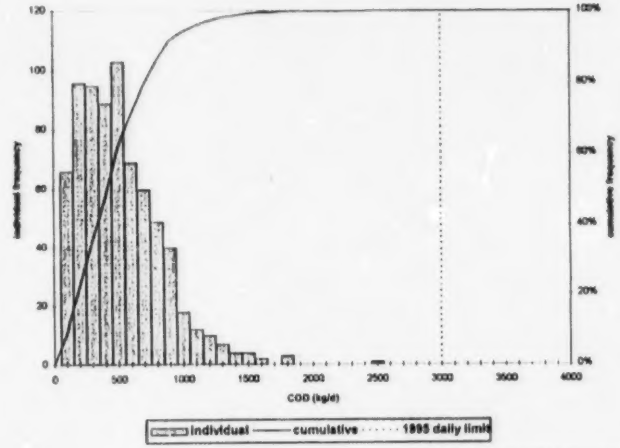
ammonia calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg-N/d)	s (kg-N/d)	x (kg-N/d)	s (kg-N/d)	x (kg-N/d)	s (kg-N/d)	x (kg-N/d)	s (kg-N/d)	x (kg-N/d)	s (kg-N/d)	x (kg-N/d)	s (kg-N/d)	daily	monthly
Suncor	4.9	8.7	5.2	10.0	8.4	7.3	10.5	15.3	7.0	6.6	4.2	5.2	70	25

Chemical Oxygen Demand
(COD)



Performance Summary: Tar Sands Plants
Individual Daily COD Loading - Time Series
Suncor Incorporated: 1990-1995

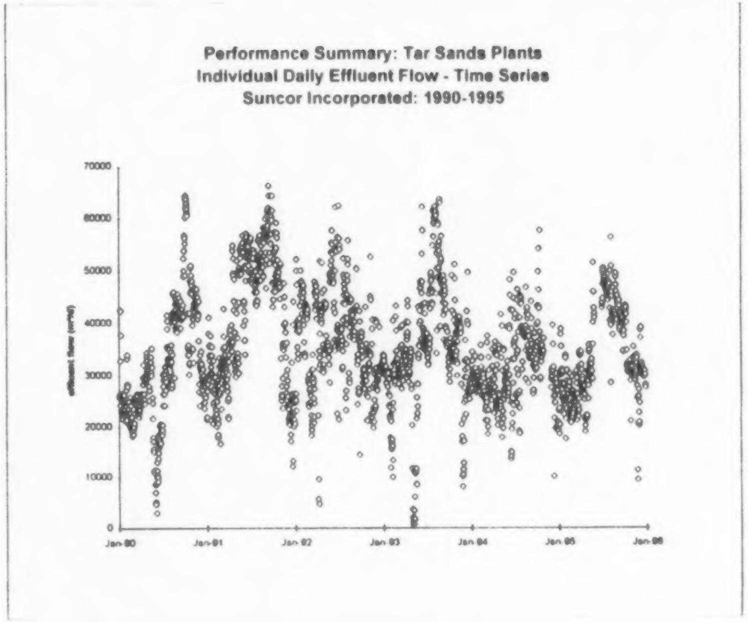


Performance Summary: Tar Sands Plants
Individual Daily COD Loading - Frequency Distribution
Suncor Incorporated: 1990-1995

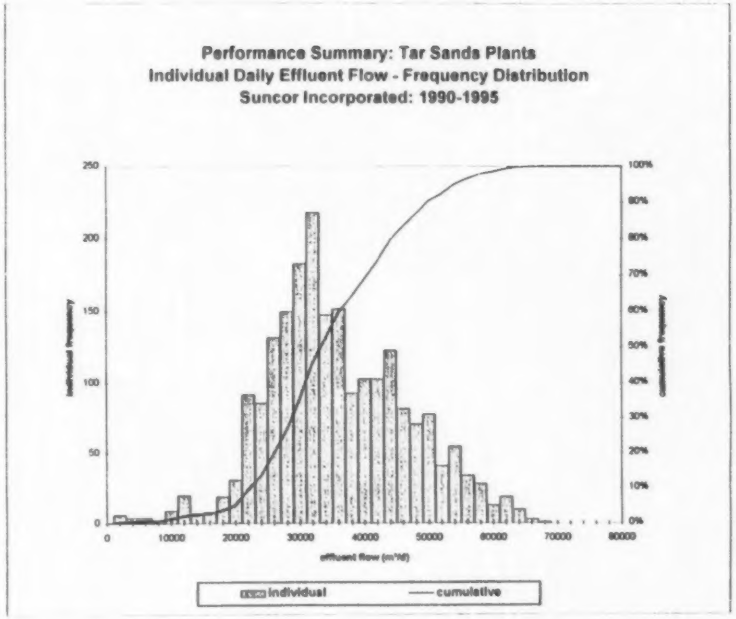
COD: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Suncor	387.6	311.7	385.8	258.7	441.3	408.5	401.9	301.3	557.9	270.7	563.3	287.0	3000	1200

Effluent Flow



Performance Summary: Tar Sands Plants
Individual Daily Effluent Flow - Time Series
Suncor Incorporated: 1990-1995



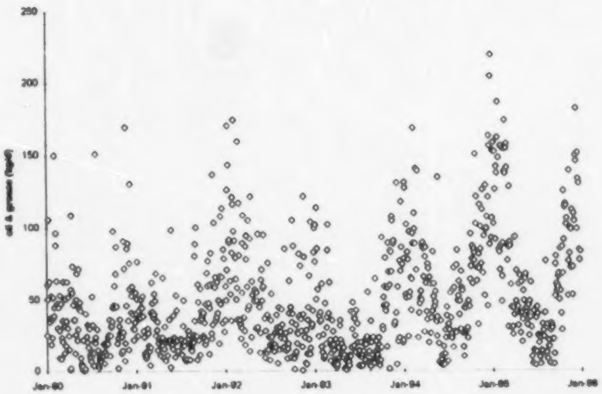
Performance Summary: Tar Sands Plants
Individual Daily Effluent Flow - Frequency Distribution
Suncor Incorporated: 1990-1995

effluent flow: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

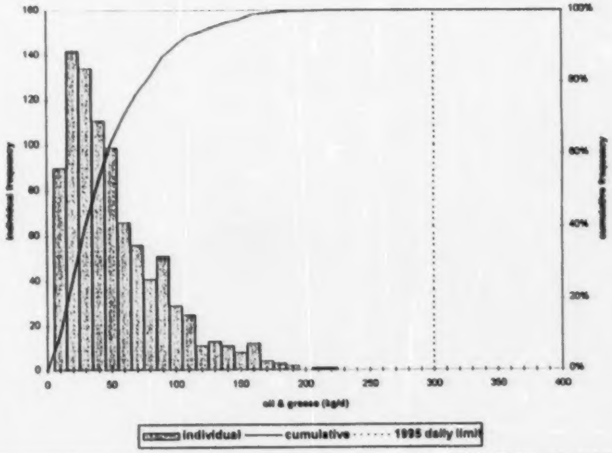
	1990		1991		1992		1993		1994		1995		1995 imposed limits (m³/d):	
plant	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	x (m³/d)	s (m³/d)	daily	monthly
Suncor	31228.7	11087.0	40834.6	12541.8	36997.3	9327.5	34787.0	12188.8	31247.0	7037.7	33358.3	8564.8	-	-

Oil & Grease

Performance Summary: Tar Sands Plants
Individual Daily Oil & Grease Loading - Time Series
Suncor Incorporated: 1990-1995



Performance Summary: Tar Sands Plants
Individual Daily Oil & Grease Loading - Frequency Distribution
Suncor Incorporated: 1990-1995

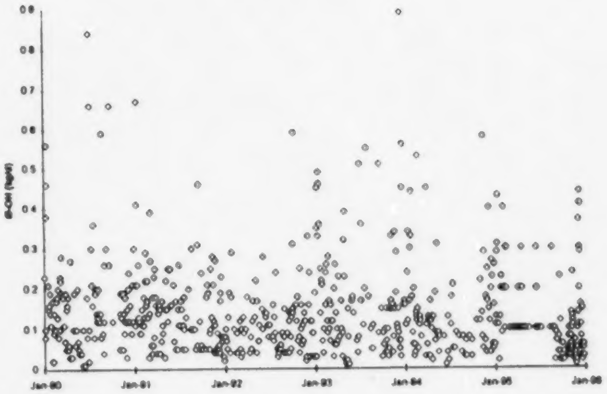


oil & grease: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

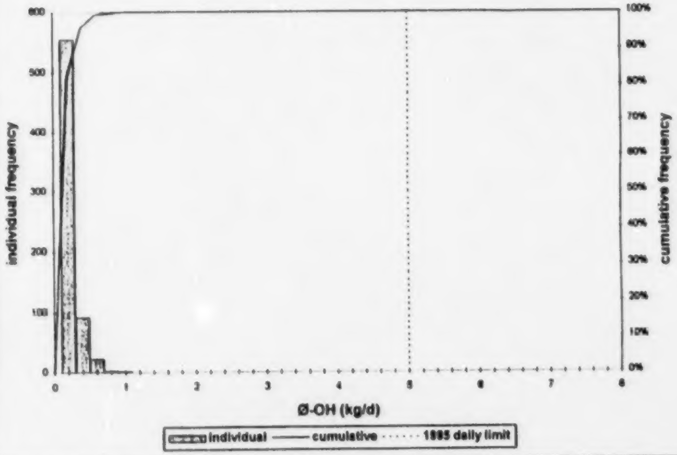
	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Suncor	37.2	29.9	36.5	24.6	49.0	36.0	32.2	29.6	63.8	39.8	68.7	45.8	300	150

Phenols

Performance Summary: Tar Sands Plants
Individual Daily Phenols Loading - Time Series
Suncor Incorporated: 1990-1995



Performance Summary: Tar Sands Plants
Individual Daily Phenols Loading - Frequency Distribution
Suncor Incorporated: 1990-1995

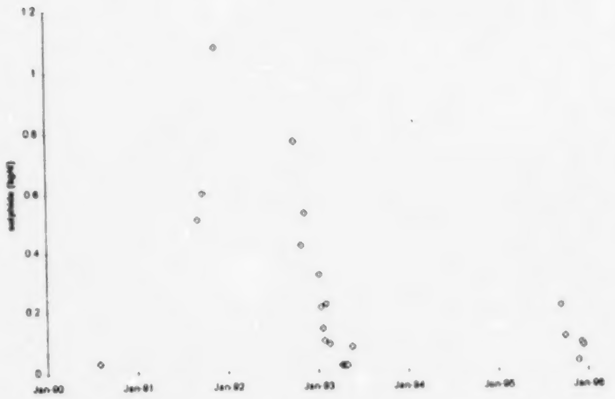


phenols: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

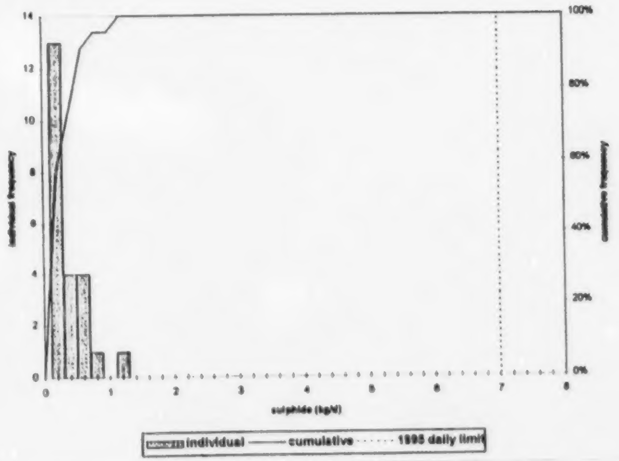
	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Suncor	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	5	2

Sulphide

Performance Summary: Tar Sands Plants
Individual Daily Sulphide Loading - Time Series
Suncor Incorporated: 1990-1995



Performance Summary: Tar Sands Plants
Individual Daily Sulphide Loading - Frequency Distribution
Suncor Incorporated: 1990-1995

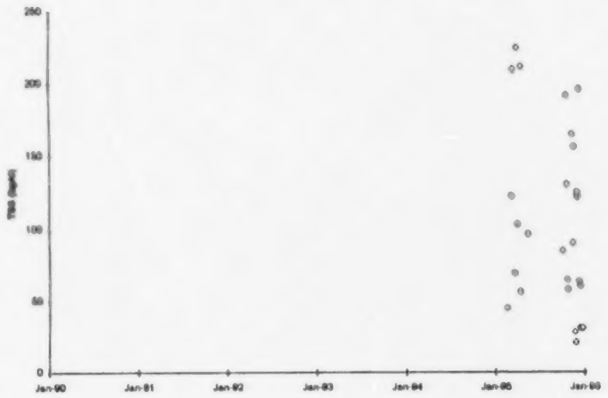


sulphide: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

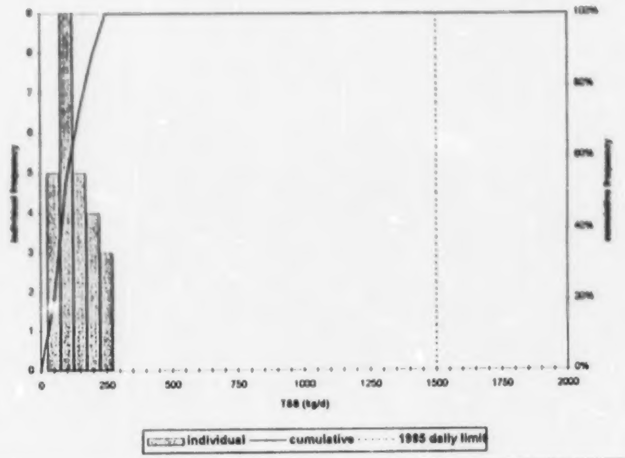
	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Suncor	0.0	-	0.7	0.3	0.6	0.2	0.1	0.1	-	-	0.1	0.1	7.0	3.8

Total Suspended Solids
(TSS)

Performance Summary: Tar Sands Plants
Individual Daily TSS Loading - Time Series
Suncor Incorporated: 1990-1995



Performance Summary: Tar Sands Plants
Individual Daily TSS Loading - Frequency Distribution
Suncor Incorporated: 1990-1995



TSS: calculated annual average (x) and sample standard deviation (s) for each facility ; 1990-1995

	1990		1991		1992		1993		1994		1995		1995 imposed limits (kg/d):	
plant	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	x (kg/d)	s (kg/d)	daily	monthly
Suncor	-	-	-	-	-	-	-	-	-	-	108.2	63.2	1500	1000

Appendices

APPENDIX 1 - REGULATED PARAMETERS

Industry/sector	Asphalt plants	Chemical plants	Coal processing	Concrete & cement	Secondary earth products	Fertilizers	Fish farms/hatcheries	Food processing	Foundry	Gas processing	Meat processing	Metal products	Municipal wastewater treatment plants	Potato processing	Power plants	Pulp mills	Rapeseed	Refineries	Rendering plants	Salt caverns	Sand and gravel washing	Tar sands	Wood processing
Zinc																		■					
Vinyl chloride		■																					
Urea						■																	
Uranium (235)						■																	
Turbidity			■												■								
TSS		■	■	■		■	■	■	■	■	■		■	■	■	■	■	■					
TP-PO4							■																
TP (if required)													■										
toxicity									■	■						■							
Total Phenols																■							
Total Nitrogen															■								
total metals									■														
Total Hardness										■													
Total Chlorine											■												
Total and Dissolved																	■						
TON								■															
TOC		■		■		■		■								■							
TKN		■					■										■						
Temperature		■		■											■	■							
TDS		■		■						■					■								
TDP-PO4							■																
Sulphide																		■					
Sodium																■							
Sulphate		■								■						■							
Specific Conductance																■							
settleable solids			■																				
Selenastrum																■							
Resin and Fatty Acids																■							
Reactive P															■								
Rainbow trout		■				■		■							■	■	■	■					
Phosphorous		■						■							■			■					
Phosphate						■				■													
Phenols																		■					
pH		■	■	■		■	■	■	■	■	■				■	■	■	■					
PCP																							
Organic-Nitrogen		■				■																	
Organic Priority																■							
Oil & Grease		■	■	■		■			■	■	■				■		■	■					
Nutrients																■							
NO3-N			■				■										■						
NO2-N			■														■						
NH3-N		■		■		■	■	■		■	■					■	■	■					
Microtox										■													
Major ions																■							
Iron			■	■					■					■	■								
Hydrogen Peroxide		■																					
Heavy Metals		■		■						■					■	■		■					
Gross-Beta						■																	
Gross-Alpha						■																	
Free chlorine residual										■					■								
Flow		■	■	■		■		■	■	■	■			■	■	■	■	■					
flouride									■														
Fecal Coliform											■					■							
fathead minnow																■							
EDTA																■							
EC		■																					
DOC		■				■				■						■							
Dissolved Oxygen															■								
Dioxin & Furans																							
Daphnia Magna		■						■							■	■	■	■					
copper																							
Conductivity										■													
Colour																■							
Coliform													■										
COD		■		■		■			■	■					■	■	■	■					
chromium																							
Chlorine Residual				■																			
Chlorinated Phenolics																							
Chloride		■						■		■													
Ceriodaphnia dubia																■							
BODu																■							
BOD5		■	■			■	■	■			■		■	■		■	■						
BOD1																■							
arsenic																							
AOX																							
Aluminum									■														
Alkyl Benzenes		■																					

APPENDIX 2 - GLOSSARY OF TERMS

AOX	adsorbable organic halogens (also adsorbable halogenated organics)
AEP	Alberta Environmental Protection
ADMTD	air-dried metric tons per day; commonly used by pulp & paper industry in the quantitative expression of pulp production
BKP	bleached kraft process; one of two general pulping processes employed in Alberta, BKP relies primarily on chemical agents to produce a suitable pulp
BOD	biochemical oxygen demand
COD	chemical oxygen demand
CTMP	chemithermomechanical process; the second of two general pulping processes employed in Alberta, CTMP relies primarily upon high temperature and mechanical pulverization as opposed to chemical oxidizing agents to produce a suitable pulp
DHA	dehydroabietic acid; a naturally occurring resin acid released from the wood in trace quantities during pulping operations
μg, μg/l	microgram, microgram per litre $1\ \mu g = 10^{-6}\ g = 10^{-3}\ kg$
Ml, Ml/d	megalitre, megalitre of flow per day $1\ Ml = 1000\ kl = 1000 m^3$ (if water) = $10^6\ kg$ (if water)
NFR	non-filterable residue; equivalent to non-filterable total suspended solids but is not the same as TSS
NH_3-N	total mass of ammonia expressed as an equivalent mass of atomic nitrogen
ng, ng/l	nanogram, nanogram per litre $1\ ng = 10^{-9}\ g = 10^{-6}\ kg$
organic N	see TKN
pg, pg/l	picogram, picogram per litre $1\ pg = 10^{-12}\ g = 10^{-9}\ kg$

PO_4^{3-}-P	total mass of phosphate ion expressed as an equivalent mass of atomic phosphorous
ppm	parts per million (by mass) 1 g of substance in 10^6 g of liquid 1 ppm = 1 mg/l (in water)
ppb	parts per billion (by mass) 1 g of substance in 10^9 g of liquid 1 ppm = 1 μg/l (in water)
ppt	parts per trillion (by mass) 1 g of substance in 10^{12} g of liquid 1 ppt = 1 ng/l (in water)
ppq	parts per quadrillion (by mass) 1 g of substance in 10^{15} g of liquid 1 ppq = 1 pg/l (in water)
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzo-p-furan
TKN	total Kjeldahl nitrogen, an effluent quality parameter which expresses the total amount of organic nitrogen existing in the $-NH_3$ structure, including ammonia ; TKN less ammonia yields *organic nitrogen*
TOC	total organic carbon
TSS	total suspended solids

1. shown only for the eight highlighted sectors

2. With the exception of pulp & paper mills, specific opening dates are stated only if the facility opened after 1990; otherwise, the date is designated as pre-1990.